# SCIENCE.

FRIDAY, JANUARY 18, 1884.

## *COMMENT AND CRITICISM.*

The Philadelphia local committee for the reception of the American and British associations for the advancement of science, which will meet in that city on the 3d of next September, is taking active steps to make the meeting a memorable one. The well-known hospitality of Philadelphia, together with the unusual attractions offered by the combined meeting of the two great scientific bodies, will undoubtedly secure a very large attendance. Under the auspices of the Franklin institute, an international electrical exhibition will be opened simultaneously with the meeting of the associations, and a congress of electricians will at the same time be convened. Excursions of unusual interest and extent are being planned. Hon. John Welsh is president, and Prof. H. Carvill Lewis and Dr. E. J. Nolan secretaries, of the local committee, which consists of a hundred and fifty of the most influential citizens, representing all the prominent institutions of the city. Communications for the local committee should be addressed to its headquarters, — the Academy of natural sciences. The meeting will probably be held in the buildings of the University of Pennsylvania, which have been offered for that purpose.

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It is sincerely to be hoped that the local committee at Montreal will take no steps which, by excursions or otherwise, may prevent a full attendance at Philadelphia of members of the British association. The committees at Montreal and Philadelphia should work harmoniously, arranging for combined excursions at the close of the Philadelphia meeting. With the aid of the Montreal committee, the Philadelphia meeting can be made the most important scientific gathering that has ever been held in this country.

No. 50. — 1884.

Mr. Theodore Link, in the *Naturalist* for December, pleads forcibly for the betterment of zoölogical gardens. These ordinarily are, indeed, to speak paradoxically, nothing but stationary travelling-shows, — Barnum's menageries called to a halt. What is required for the animals' happiness and health is obvious enough; but, as questions like the present are generally decided from man's point of view, let us shift to that. The mission of these gardens, as Mr. Link says, is ostensibly "the study and dissemination of a knowledge of the natural habits of the animal kingdom." Therefore an opportunity for such habits among these animals is essential to the student visiting them. Perhaps most visitors, however, go for amusement, or for the pleasure of easy instruction. We go to see something opposite to the restraints of our own civilization, to behold the wonders of untrammelled instincts, to enjoy the beauties of free motion. But as it is, we seek a pleasure-garden, and find it a prison. We find no animated vigor there to cheer and to excite us, but helpless misery too much like the poorer side of human life.

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The great difficulty, it seems to us, is in attempting with limited means too big and miscellaneous collections, imperfect, unsatisfactory, and uninstructive, about in proportion to their excess of size. Would it not be better in a given half-acre to have a single pair of lions, or of any other much admired brute, rather than a subdued camel, a cramped tiger, a dilapidated ostrich, and a discouraged crocodile, all obliged to stand as nearly as possible on one leg, for want of any thing better to do? Any chance and inducement given to the animals to breed naturally and freely, certainly might be a direct and valuable economy to any zoölogical society in keeping up its stock.

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According to a communication made to the London section of the Society of chemical in-

dustry by Mr. Weldon, it does not seem that we are much nearer to cheap aluminium than we have been for a long time. A short time since, it was announced that a new method of production had been invented and was in use; but Mr. Weldon says this invention only relates to the production of anhydrous alumina from potash alum; and, if the method of obtaining this were fifty per cent cheaper than that of M. Pechiney of Salindres, it would only cheapen aluminium by five per cent.

APROPOS of the present discussion of the excessive requirements of Greek and Latin in our colleges, let us not forget the neglect of English. One of the reasons most commonly given for the study of the ancient languages is that they aid the understanding of our own. This is undoubtedly true, but they are not the best aids; and if a good understanding of English be the desired end, as it certainly should be, there can be no question that it will be sooner and better attained by the study of English itself. The derivation of our words can be very satisfactorily taught along with advanced spelling, and the meaning of a large number of roots, prefixes, and suffixes, can then be acquired, so as to give most practical assistance to the comprehension of English; much better, we venture to say, than if etymological study be limited to the languages from which the roots, prefixes, and suffixes come, and direct statement of their use in building up our own language be omitted. It is certainly very common to find students who have 'passed' in Greek and Latin still unable to explain the meaning of not unusual scientific terms. Indeed, so large a share of the time allowed to linguistic study is now given to Greek and Latin considered simply as dead languages, without reference to their living descendants, that no time is left in which the general student can learn what he certainly should know about his mother-tongue.

There is pressing need of collegiate study of English as a language: and few subjects would be more attractive than this might be made by a lecturer who would tell his class where and when the language attained enough of its present characteristics to be entitled to its present name, what were its ancestors, and how they mingled and changed their form in producing their descendant; who would describe how the language itself has varied in recent centuries, and how its unsystematic spelling, so unlike the phonetic simplicity of Italian and Spanish, depends on its complex origin; who would point out the historic reasons for its *dependence* on earlier languages for words expressing abstract ideas, in contrast with the relative *unabhängigkeit* of German. All this would no more require a knowledge of ancient or foreign languages than an appreciation of elementary lectures on chemistry needs an understanding of organic analysis; but it would give a very different knowledge of English from that derived from the study of Latin declensions and Greek accents. We cannot doubt that it would be of great service to all who have to write out what they think, and that it would attract to philological studies many students who are now repelled from them.

WE understand that the scientific work of the Army signal-office is likely to form a feature of increasing importance in the future development of that department, and that Gen. Hazen desires to secure the services of the best talent in the country. It would seem that the study of mathematics, mechanics, and physics, as bearing on meteorology, has been sadly neglected in our universities; and it is by no means easy to find any who have been studying the sciences with a view to the pursuit of investigations in meteorology. As a general rule, those who have studied and practised astronomy for a few years are the best prepared to advance meteorology. The fine library of the signal-office, its unequalled mass of observations and maps, its courses of lectures, its annual classes of men under instruction at Fort Myer, its collection of apparatus, all offer to young meteorologists opportunity and stimulus to farther advancement; while the publications of the office offer every facility for making known the results of origi-

nal investigations. Even meteorologists outside the office, or employed by it as consulting specialists, may find it to their advantage to avail themselves of this opportunity for publication. Considering the great future evidently in store for meteorology, it is not surprising that Professor Abbe is, as we understand, diligently inquiring for those who are willing to come to his assistance in the effort to develop a systematic, deductive, and exact science of meteorology. We commend this subject to those whose studies have taken this direction. There are needed the investigator, the teacher, and the expert consulting-meteorologist, precisely as in other branches of science.

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## LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

### Chemical geology.

IT appears to me, that in his interesting communication in the number of *Science* for Dec. 28, Professor Winchell has fallen into an error, which, while diminishing by more than one-eighth his estimate of the secular increase of the earth's mass, is yet more serious from the stand-point of chemical geology. In determining the amount of carbon dioxide abstracted from the atmosphere and fixed in the earth's crust, he estimates, first, that represented by the carbonate rocks (limestone, dolomite, etc.), and, second, that required for the decomposition of an assumed thickness of decomposable silicate rocks; and both these amounts are included in his grand total. But this is certainly bad book-keeping, for a portion of the carbon dioxide is counted twice. The decay of the silicate rocks is a necessary antecedent of the formation of the carbonate rocks; and the carbon dioxide of the latter is precisely the same as that which has previously decomposed the former. In general terms, this grandest of all chemical processes proceeds as follows: the carbon dioxide of the atmosphere decomposes the felspars, hornblende, augite, micas, etc., of the silicate rocks, leaving the alumina and iron with the silica as a more or less ferruginous kaoline, and forming carbonates of the alkalies and alkaline earths, which are carried away in solution, and ultimately reach the sea, where the latter are deposited as limestone and dolomite, and the former react with the calcium and magnesium chlorides of the sea-water, producing alkaline chlorides (chiefly common salt) and more limestone and dolomite. As Dr. Hunt has so clearly shown, the kaoline on the land, and salt in the sea, are merely incidental results of the fixation of the carbon dioxide of the atmosphere in the carbonate rocks. W. O. CROSBY.

### Osteology of the cormorant.

Dr. Shufeldt's letter in *Science* (ii. 822) calls for a few remarks. In relation to his first statement, that 'the occipital style of the cormorant is not an ossification in the tendon of any muscle' of the neck, Selenka wrote as follows: "Eigenthümlich ist dem Carbo cormoranus und C. graculus, aber auch nur diesen beiden, ein an dem *occip. superius* durch bandmasse verbundener, dreieckig pyramidenförmiger, nach hinten gerichteter knochen, welcher die ansatzfläche der den kopf bewegenden muskeln soz. vergrössert; er ist ein sehnenknochen und gehört nicht zum schädel" (Thierreichs, 19). In view of such eminent authority, it would seem that something more than simple denial is required to upset a statement accepted by anatomists for many years. It is worthy of note that Dr. Shufeldt does not mention the nature of the bone in his article, and that, in ignoring the point to which I took exception, he virtually acknowledges his mistake. It is difficult to understand how one who does not know the position of a bone is qualified to expound its nature; and in all cases it is wise, if we would convince, to give reasons for dissent from authorities.

As to his second statement, that my ideas of the morphology of the rotular process are wrong, I would simply remark that the ideas referred to are not mine, but those of Nitzsch, of Meckel, of Tiedemann, of Owen, of Selenka, and of Mivart, and suggest that it would be appropriate to read such eminent authorities before disposing of them with an empirical denial. Dr. Shufeldt's paper clearly intimates that the rotular process of the divers is the homologue of the patella in other birds. The coexistence of the two disproves this by *reductio ad absurdum.* I would invite Dr. Shufeldt to quote the passage to which he refers when citing Owen as considering any process of the tibia as the analogue of the patella.

Lastly, Dr. Shufeldt states "that, furthermore, I find myself misquoted more than once." I would remind Dr. Shufeldt that I quoted him but once; and of the accuracy of this, any one may satisfy himself by referring to *Science*, ii. 642, 2d column, line 19.

J. AMORY JEFFRIES.

### Electric time-signals.

Your correspondent who describes his method of making electrical signals in a recent number of *Science* (ii. 823) can greatly simplify and thereby improve his arrangement by inserting within the clock a couple of thin metallic springs with platinum contacts, the circuit being completed by the pressure of the hammer on the 'outward stroke.' The writer has had such an attachment to an ordinary 'programme clock' in constant use for about ten years, as is doubtless the case with many others who have had occasion to distribute time. The signals are transmitted to several buildings, in one of which an electric gong is struck, and in others a number of 'vibrating' bells are rung.

Mercury contacts are generally troublesome. The arrangement described seems unnecessarily complicated: besides, it is difficult to see the necessity for insulating the clock 'on a square of plate glass.'

M.

Columbus, O.

### Capitalization of names of formations.

The use of capitals is a literary rather than a scientific matter; but geologists, nevertheless, suffer as a class from the existing confusion in regard to the names of formations.

Authors who are consistent with themselves in this matter fall into three classes. Those of the first class speak of the *P*otsdam, and of the *C*arboniferous, but of *p*otsdam strata and *c*arboniferous strata. In so doing they class the names of formations as proper nouns, but refuse to recognize proper adjectives. This practice employs a German idiom not otherwise countenanced in our language: we do not say *g*erman

idiom. Another objection is, that the practice introduces a distinction difficult to maintain on account of the graduation of the nominal into the adjective sense. 'The Carboniferous' may or may not imply some such noun as formation, and the degree of such implication is variable.

Authors of the second group speak of the *P*otsdam and *P*otsdam strata, but of the *c*arboniferous and *c*arboniferous strata. The distinction thus made is etymologic, being based on the immediate derivation of the name of the formation. To this there are two objections. First, it is contrary to the analogies of the language, for capitalization is generally controlled by meaning. We speak of 'the *P*acific,' although the designation is etymologically a common noun; and we call the recently popular feminine waist-gear a *j*ersey, although the designation is etymologically a proper noun. Second, it has the effect of recalling attention continually to the derivation of names, and thus retaining their connotative meaning. For mnemonic reasons, and for these only, it is convenient that names of formations should originally be connotative, but it is of prime importance that they should eventually become merely denotative. There was a certain original utility in having 'Potsdam' call to mind a place, and 'carboniferous' a character; but the names having become securely attached to their several formations, it is now imperatively demanded that each shall designate a certain portion of the stratigraphic column and a certain portion of geologic time, without connotating place or composition. Indeed, the reason why modern usage employs geographic terms in the naming of new formations, instead of designating them by their physical characters, is that a minimum of connotation is thus secured from the outset.

Authors of the third class capitalize all names of formations, whether used as nouns or adjectives, and in so doing escape these evils. The only objection I see to their practice is, that it classes with proper nouns a group of names which may fairly be compared with other groups not so classed. The demarcation between common and proper nouns is essentially somewhat obscure; and the drawing of the line is largely a matter of practical convenience. It is noteworthy that no author whatever has so drawn it as to include all names of formations with common nouns.

The capitalization of all formation names has the manifest advantage that it enables one to say that the *C*arboniferous rocks are not the only carboniferous rocks, or, in other words, that it does not deprive the geologist of the independent use of words indicative of rock character which have been appropriated for the names of formations. If the use of capitals were altogether discarded in the designation of formations, this advantage would be lost, but another would be gained; for we should then be able to speak of the rocks of *P*otsdam without implying their *p*otsdam age. G. K. GILBERT.

### Remsen's 'Theoretical chemistry.'

Will you kindly allow me to correct an error into which it seems that I fell, in my notice of Professor Remsen's 'Theoretical chemistry' (*Science*, ii. 826)? It cannot be denied that the statement, "Of the substitution products of benzene which contain three substituting groups, more than three varieties have been observed," is literally true. The context and form of expression were such that I could not but think this assertion was made of those derivatives in which the three substituting groups were alike. Had it occurred to me that the statement was not thus limited, I certainly should not have pronounced it rash, but so cautious and incomplete that it must inevitably mislead even the most careful reader.

THE CRITIC.

### Synchronism of geological formations.

I trust that you will permit me a little more space to reply to the further remarks of Mr. Nugent on this subject (*Science*, iii. 33), seeing that your correspondent has failed to grasp the point which I had intended to elucidate in my last communication.

Mr. Nugent is correct when he contends that I rest my case on the non-occurrence of 'evidences of inversions;' and, if my line of argument based on this fact fails to meet with his approval, I sincerely regret it. Paleontology, as far as I am aware, has thus far failed to show a single unequivocal case of faunal inversion such as I have indicated; nor does there appear at the present time very much likelihood of its ever being able to do so. Nor would the discovery of a solitary instance materially affect the question, inasmuch as, upon the theory of very broad contemporaneity suggested by Huxley, instances of inversion ought to be about as numerous as those of non-inversion. My courteous critic admits that "there is no reason why such instances of inversion should not have occurred over and over again," and that at the present time their 'occurrence is almost unknown;' but his appeal to the 'imperfection of the geological record' (both geological and geographical), in explanation of the overwhelming negative testimony, will, I am afraid, scarcely meet the situation.

The special cases referred to — Barrande's colonies, and the intermixture of Silurian and Devonian, and Devonian and carboniferous fossils in the old red sandstone of Scotland — are far from being of the character desired. The former need scarcely to be commented upon, since they have always been involved in a certain amount of obscurity; and their very existence as such has very recently been denied by Marr, who personally examined the region, Lapworth, and a host of other geologists. In the case of the old red sandstone of Arran, where there is an intercalation of a band of marine limestone containing Productus giganteus, P. semireticulatus, P. punctatus, Chonetes hardrensis, Spirifera lineata, and other well-known carboniferous fossils, Professor Geikie (who, we believe, first made the observation) distinctly affirms that these organisms must "have been in existence long before the formation of the thick Arran limestone," and that their habitat during the period of the deposition of the underlying sandstone was immediately outside of the basin or basins that through upheaval were now being gradually isolated from the sea: in other words, we have here merely an instance where the range of a certain number of organic forms has been extended somewhat lower down in the geological scale than it had hitherto been indicated. These same forms re-appear in the superimposed lower carboniferous limestones, and, as Professor Geikie observes, they must have been living during the long interval coincident with the sedimentation of the intervening sandstone 'outside of the upper old red sandstone area.' The same relation holds with the Siluro-Devonian mixture in the basal old red of Lanarkshire. No one can deny the local displacement and interchange of portions of two consecutive faunas, especially at about the beginning or close of their own respective series; but these displacements are not of the nature of the inversions that ought to illustrate the doctrine of broad contemporaneity.

To what extent similar or identical faunas indicate *absolute* chronological relationship can probably never

be determined; but I believe it may be safely assumed that the synchronism is defined within comparatively narrow limits; or, as previously expressed, "formations characterized by the same or very nearly related faunas in widely separated regions belong, in very moderate limits, to approximately the same actual age, and are to all intents and purposes synchronous or contemporaneous" (*Science*, No. 41). Professor Geikie, who is quoted by your correspondent as supporting the orthodox doctrine of homotaxis, or homotaxis in its broadest limits, judiciously refers to chronological divergences of only *thousands* of years, and *not* of *millions* ('Text-book of geology,' pp. 617–619). ANGELO HEILPRIN.

Academy of natural sciences, Philadelphia,
Jan. 12, 1884.

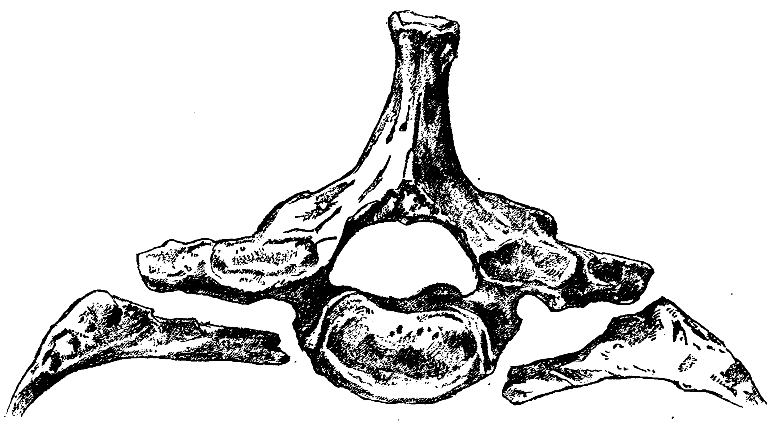
### Free cervical ribs in the human subject.

I send you a photograph of a notable and very interesting anatomical preparation well worthy of being engraved and published in *Science*. It is the seventh cervical vertebra of the human subject, natural size, viewed from above, showing a pair of free cervical ribs. This demonstrates the fact that the so-called transverse process of a cervical vertebra consists of a diapophysis with a coalesced pleurapophysis, the vertebrarterial foramen so characteristic of cervical vertebrae being an opening between these two apophyses. The photograph shows the preparation so well that little description is required. The whole bone is seen to be a little distorted, and the two ribs are seen to be of different shape and size. The ribs are photographed a little apart from their respective articulations, otherwise *in situ*. Each freely articulates, as usual with ribs, by its head with the body, and by its shoulder with the diapophysis, of the vertebra. The base of each diapophysis presents anteriorly a nick (deeper and more regular on the left than on the right side) which is a part of the vertebrarterial foramen proper, the rest of which is circumscribed by the rib itself; the whole space between the vertebra and the neck of the rib being thus a large continuous opening of irregular contour.

The lower border of the body of this vertebra presents on each side a demifacet (not shown) for half of the head of the next (first dorsal) rib; so that the first dorsal vertebra must also have been anomalous in possessing two demifacets, instead of a full facet above and a demi-one below. The same subject was also badly put together in some other respects; e.g., one of the long thoracic ribs (I think the fifth) bifurcated at the sternal end. The specimens were handed to me by one of my pupils, Mr. Arthur J. Hall. The anomaly here figured, while not new, is so rare that I think I have seen but one illustration of it; namely, that given by Professor Owen in his 'Comparative anatomy and physiology of vertebrates.'

ELLIOTT COUES.

Smithsonian institution, Washington,
Jan. 4, 1884.



Seventh cervical vertebra of the human subject, life size, seen from above; showing well-developed and freely articulated pair of cervical ribs.

### A possible solution of the standard time question.

Although the adoption of five standards of time for the movement of railroad-trains in the United States has simplified the time question for the travelling public, I believe it is a matter of deep regret, that, since a change has been made, that change could not have been to a single standard instead of five, and that Greenwich time, as Mr. Schott very significantly queries in *Science*, No. 38. This is the more to be regretted, since the railroad companies have found it impracticable to make the changes on the proposed meridians, and since, as Mr. Schott rightly apprehends, all ordinary business must always be conducted on local mean solar time.

It appears to me that this whole question could be very simply and forever settled by the adoption of Greenwich time for the movement of all public conveyances the world over, and the construction of time-pieces which would indicate at once both local mean solar time and Greenwich time. The only modification of the ordinary time-pieces needed, to enable them to indicate both times, is to provide them with two dials, one of which shall be movable about an axis, and capable of being set at any desired point. It is immaterial which dial is stationary: the same set of hands would sweep both dials, and indicate, of course, both times, at once. Thus provided, a person desiring to take the next train would be governed simply by the Greenwich dial. Furthermore, should his time-piece lose or gain, it would only be necessary to set it by either local mean solar time or by that of

any station, to have it right again both at home and with the world.

The adoption of such a standard would not necessitate the substitution of new time-pieces for those now in use, nor expensive alteration of them. A very simple, inexpensive way of adapting existing watches to the suggested change would be to etch the Greenwich dial upon the watch-crystal in a little smaller circle than that of the dial proper. The crystal could then be set to indicate the difference of time between the given place and Greenwich, and secured by a little white wax. Clocks could be similarly changed also.

If the hours are to be read from one to twenty-four, as seems desirable, and as some roads have already agreed to do, this will necessitate not only a change in the rate of motion of the hour-hand of time-pieces, but in the dial also. Now, since a change is to be made anyway, why not avoid twice changing by reconsidering at once the action already taken, and move immediately in the direction Mr. Schott has suggested. This would avoid the necessity of publishing in time-tables local times; while the traveller would have simply to consult his time-table, and refer to his Greenwich dial, to know at what moment to take a public conveyance, not only anywhere in the United States, but anywhere in the civilized world. Train-men and station-hands could experience no inconvenience in being guided by their Greenwich dial, it being necessary simply to make that dial the more conspicuous which is to be consulted oftenest.

F. H. KING.

River Falls, Wis.

## *THE DUTY ON IMPORTED SCIENTIFIC TEXT-BOOKS.*

AT the last meeting of the American association for the advancement of science, there was some discussion of the effects of the existing tariff on foreign text-books on our school system. This is the first considerable effort to call the public attention to the results of our Chinese commercial policy upon the education of our youth. That system of policy is such a vast elaboration of rules, and the effects of its regulations are so hard to trace in the machinery of our society, that it has derived a strength and a safety from its very magnitude and its obscurity. The ordinary mind shrinks from the effort to trace the complication of its effects on great labor-employing industries like pig-iron manufacture. It requires the courage of a great soldier to give battle to the tariff on such fields; for, however convinced the free-trader may be of the right of his cause, he sees that his victory will mean destruction to many whom he cannot regard as foes. But here and there around the tariff jungle there are places that may be improved without danger of any serious consequences to great interests. Some years ago, in a lapse into discretion, if not into rationality, the tariff men took off the duty on quinine. A few score men had to seek other employment, probably to their serious but not permanent inconvenience, and that greatest of all helpers of the sick was free to go untaxed to its users.

As real though less sympathetic claim may be urged for the removal of the tax on educational materials and methods. Even in our money-earning state of society the amount that can be spared for the education of our children is so small that such money should be the last thing to receive the burden of taxation. What would have been thought, if in the fiercest struggle of the war, when we were taxing the physician's right to minister and the drug's power to heal, if some legislator had proposed to tax each college-student, say, three dollars a year, for the privilege of pursuing his education in the most effective manner? Taxes on this principle may be warranted in a besieged city; but even on our darkest day such a measure would have been laughed out of Congress, would have been denied even the rites of decent burial in a committee. Yet substantially this is what is practically done in this day of unparalleled prosperity, when, for the first time in all history, a government is sore burdened with its revenues. A commission of well-paid experts, charged to contrive some means to clear away this excess of income, retains this amazing tax after a year of pondering on the subject!

The singular character of the tax is evident enough in the most general statement of its nature, but close inquiry shows us that it becomes even less comprehensible the better we understand its details. The books excluded by the tax are not the spellers, readers, arithmetics, etc., that are made by the million. Against these, no foreign books would stand any chance whatever, unless they were introduced to the schools through the existing publication-houses. The books that are affected by the law are those that have at best a narrow sale. They are principally books in French, German, Latin, or Greek, used only in college classes for special purposes, which it would not pay any American publisher to reproduce. But let us suppose that the English, German, or other printers could furnish a set of school-books so decidedly better and cheaper than our own that our thrifty publishers should be driven from the field: will any reasonable man say that we should continue to maintain them by a head-money tax on the pupils of our schools?

There is no good reason to fear that our publishers would lose by a free trade in educational materials. If the change be made in such fashion that they may have as good a chance in foreign markets as foreigners should have in our own, we can trust the business

capacities, and the stimulated energies of our text-book makers, to keep our place in the struggle. But grant the truth of the sad presages of those who see the deluge in free trade, can we afford either the principle or the effects of levying a poll-tax on education?

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## WHIRLWINDS, CYCLONES, AND TORNADOES.[1]—VIII.

THE barometer was falling more and more rapidly, and the wind blowing with increased violence from the north, in the example that was described. Then, if a transparent storm-card, drawn to proper scale after the pattern of fig. 9, be placed on the chart so that its strong north wind shall pass the position of the vessel, it will give the best indication of the general form of the hurricane; and a course may be laid by which the dangerous centre will be avoided. In this case, the safest course will be to run southward, or a point or two west of south, till the barometer begins to rise; and then, if desired, a more easterly course may be followed. Even if the vessel be on its way to a European port, this will be its safest method of avoiding the storm; for, in attempting to beat against the wind and leave the storm to the south, there is too much risk that its increasing strength will prevent the vessel making sufficient headway to escape being caught in the central whirl: it would be better to sail around the southern side of the storm, and, after the centre had passed on the west, then shape a north-easterly course with the wind on the starboard beam. Sometimes it has happened from ignorance of such sailing-rules as these, or from inability, even with their aid, to escape from the sudden violence of a storm, that a vessel finds itself on the storm-track at the time of the passage of the centre; and there is then observed the peculiar and dreadful calm within the whirl, to which sailors have given the name of 'the eye of the storm.' Let us suppose, in the example given above, that the vessel endeavored to force its way against the increasing north wind, and, failing in this, remained on the path of the storm till the centre advanced on it. During its approach there will be no very marked change in the direction of the wind; but its force increases even beyond what seems its greatest possible strength, and goes on increasing, blowing in tremendous and terrible gusts, till the vessel is stripped of its canvas, and the yards and masts are cracked and broken away, and the hull lies helpless and unmanageable. Rain falls in driving torrents, and the sea rolls in great broken waves. The roaring of the winds rises to a screaming pitch; and when at its most fearful strength, it suddenly dies away. In five minutes, perhaps even less, the air is quiet; and only the heavy sea, and the commotion of the clouds, and a distant fading sound of the retreating wind, tell of the violence that has passed by. The vessel is in a cushion of quiet air left under the core of the storm. There is generally but a short time given to suffer the suspense of this unnatural quiet. In half an hour or an hour, according to the size and rate of motion of the storm, the centre passes away, and the opposite side of the whirl suddenly falls on the unhappy wreck, coming again with all the roar and fury that was felt before, but now blowing in the opposite direction, — a terrific hurricane from the south, chopping the waves into the dreaded cross-sea, where the water rises in pyramids instead of in linear crests, and changes its form so rapidly and with such broken rhythm as to strain great leaks in the worn-out hull, and leave it to founder in clearing weather, while the storm goes on in its destructive path.

There is yet much to be learned concerning the curves followed by the winds in these storms. The diagrams, as described above, are based on observation and theory, but must be regarded only as provisional until proved by the average of many more observations than have yet been made. Rules for various cases may be easily devised on the plan above described, but they are not infallible: there is still much to be done in perfecting them. Only one additional point need be mentioned: care is needed to avoid sailing after and overtaking a slow-moving storm, and so falling into its power. This would seldom happen in our latitude, but might well occur in the Indian Ocean, where some storms have been found to rest almost stationary over one district of the sea for more than a day. A case is reported where a vessel thus fell into the dangerous whirl, and could not escape, but was carried round and round the centre, while scudding under bare poles, till it made five complete revolutions before the storm left it behind.

There remains to be described the storm-flood produced when a storm runs upon a low shore, as often happens at the head of the Bay of Bengal. The cyclone advances with growing strength till it reaches the flat delta of the great Indian rivers. It finds the land here perfectly level, and so little raised above the water that its cultivated surface has to be pro-

[1] Continued from No. 48.

tected from river-overflows by dikes ten or twelve feet high built along the shores. But the inblowing winds brush the water of the bay up against the land; the diminished atmospheric pressure about the storm-centre allows the heavier surrounding air to lift the water here, and for every inch that the mercury falls in the barometer the water will rise a foot; the rain alone may contribute nearly a foot of water in a day; and finally, if a strong tide conspire with these other causes, a great flood is produced, that overwhelms even the dikes, and drowns out all the low country; and the poor people, unprovided with sufficient means of escape from the winds and the waters that come from above and below, are lost by the thousand. Six storms alone, that have devastated this coast since 1700, have, if the records can be trusted, destroyed over half a million lives.

The disappearance of a storm has already been alluded to. The storm will fail, or greatly decrease in strength, when running from the sea on the land; for friction here is greater, and there is less moisture in the air from which heat can be obtained to overcome the increased friction and continue the existence of the disturbance. Again: the storm must decrease in intensity as it recedes far from the equator; for it then enters regions of less warmth, and consequently less moisture. Finally, it must end when the updraught caused by heat derived from the falling rain fails to throw the overflow outside of the storm's limits; for then more air enters the storm than flows out of it, and the pressure at the centre will increase. The reverse of this is worth noting: the storm will increase in size and in total strength, although perhaps not in central intensity, as long as the updraught is active enough to throw some of its volume outside of the area occupied by the surface-indraught; for then the pressure at the centre will decrease, and the development of the embryo will continue.

Before proceeding to the consideration of tornadoes, we may devote a little space to the special features of our own storms east of the Rocky Mountains, as determined chiefly by Professor Loomis in his careful study of the signal-service maps.

The storm-areas, as indicated by the curved lines of equal pressures, are ovals about twice as long as wide, with the longer axis generally north-east and south-west. The average direction of progression of nearly five hundred storms, in 1872–74, was north 81° east, with a mean velocity of twenty-six miles an hour, or six hundred and twenty-four miles a day: the maximum velocity was above eighteen hundred miles a day. Some of these barometric depressions begin on the Pacific Ocean, or in our north-western territories; most of them are first noted within the western mountainous district; and a good share of the remainder arise on the plains. Very few come from the West Indies. After passing us, they sweep out over the ocean, generally turning well to the north-east, and, if continuing long enough, running to Norway or Iceland rather than to Great Britain. The probability that a storm which leaves our coast will arrive in England is only one in nine. The average tracks of a large number of storms from the Rocky Mountains to the Ural are shown on the accompanying map, prepared by Köppen (*Annalen der hydrographie*, 1882).

If storms moved only according to these averages, their prediction would be made easy and accurate; but they naturally fail to do so, and hurry or slacken their pace, or turn to one side or the other of their average course, in what seems to be the most capricious fashion. It is the early discovery of these individual peculiarities that tasks the acuteness of the weather-men.

With regard to velocity, storms advance much faster in February than in August (174 : 100), and in the late afternoon and evening than at other hours (125 : 100). If the telegraphic reports show a rapidly rising barometer, and a weak wind in the rear of the storm, it will probably move rapidly. The rain, also, exercises a marked control on the storm, as is shown by comparing the forward extension of the rain-area with the rate of progress: —

| Forward extension of rain. | Progression of storm-centre. |
|---|---|
| 640 miles. | 40.1 miles an hour. |
| 568 " | 29.2 " " " |
| 539 " | 22.3 " " " |
| 422 " | 15.3 " " " |

further, by comparing the axis of the rain-area with the course of the storm: —

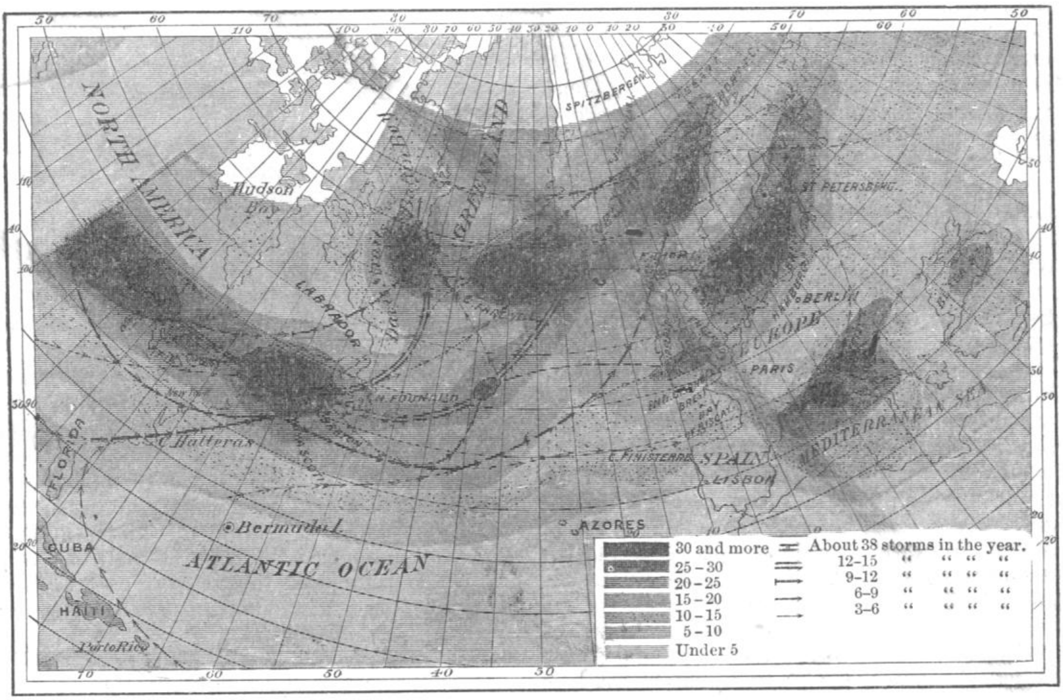
| Axis of rain-area. | Course of storm. |
|---|---|
| N. 53° E. | N. 44° E. |
| S. 65° E. | S. 69° E. |

finally, by comparing the rainfall with the increase or decrease of the central barometric depression: —

| Average rainfall within isobar 29.80″. | Change of central depression in twenty-four hours. |
|---|---|
| 0.078″ | + 0.10″ (i.e., storm decreasing). |
| 0.149 | − 0.05 |
| 0.159 | − 0.128 (i.e., storm increasing). |

Rain, therefore, is shown to aid in determining the velocity, direction, and development of our storms, as has already been inferred.

Thus far in regard to the motion of the storm as a whole. The winds of the storm blow faster, the more marked the central depression and the closer the isobars. If the space on the signal-service maps between adjoining isobars (the difference of their pressure being one-tenth of an inch) measure one hundred and thirty miles, the wind will probably blow five miles an hour; if eighty miles, thirty miles an hour; if forty-five miles, fifty miles an hour. There is, however, much variation from this rule, depending on the form of the ground and the neighborhood of the lakes or the sea. The average direction, inclination, and velocity of our storm winds in the four quadrants is shown in fig. 21. The relation of the several inclinations here shown has already been discussed. It should be added, that the unexpected approach to equality in the wind's strength on the right and left (south and north) sides of the storm is probably in large part due to the wind on the north coming but little retarded from the sea, while that on the south has lost much of its proper velocity by blowing long over land; so that, while the winds should theoretically show a less velocity on the left than on the right side of the track when the storm moves over a uniform surface, this inequality might be largely counteracted by the relations of sea and land that obtain in the eastern part of our country. This is confirmed by finding the winds on the left side of the storms of northern Europe much weaker than on the right; for here the progression of the storm, and the relation of sea and land, combine to produce this effect. Our space forbids more detailed consideration of the variation of our storms with the seasons; and the reader desirous to pursue the subject farther should provide himself with the government daily weather-maps, which may be had by subscription to the chief signal-officer in Washington, and should consult Professor Loomis's essays in the *American journal of science* for




AVERAGE TRACKS OF STORMS FROM THE ROCKY MOUNTAINS TO THE URAL.

recent years, the circular on the practical use of meteorological reports and weather-maps (issued by the signal-service, 1871), and the appendices on the relation of rain and winds, and on the course of storms in the different months, in the signal-service reports for 1878 and 1874.

(*To be concluded.*)

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## *THE INTELLIGENCE OF BATRACHIANS.*

IN his recent volume on Animal intelligence,[1] Mr. Romanes devotes less than two pages to the intelligence of batrachians. He remarks, 'On the intelligence of frogs and toads very little has to be said.' That our author should have included toads in the above seems strange; as instances of cunning, and proofs of the general intelligence, of these animals, are numerous. In conversation with practical observers of animal life, I have never yet found one that did not accord a marked degree of intelligence to toads. In short, toads may readily be tamed, will come when called, and have been seen to place matter attractive to flies, their principal food, near their hiding-places, so they could remain at home and at the same time be sure of a sufficiency of food. This evidence of foresight, on the part of toads, is no uncommon occurrence, and quite effectually establishes their claim to a creditable degree of intelligence.

Of the spade-foot or hermit toad (Scaphiopus solitarius) and the tree-toad (Hyla versicolor) I have but little to record. The former is but rarely seen, and I have had no opportunity to experiment with it with a view to testing its mental capabilities. The habits of the animal, as described by Agassiz and Putnam, would lead one to conclude that intellectually they are to be classed with the common toad. The tree-toad, or Hyla, being crepuscular in habits, was found difficult to study, and nothing was determined that bore upon the question of its intellectual capacity. I can but state my impression, which is, that they are not so cunning as the common toad.

On the other hand, I am pained to confess that my many observations and experiments with the several species of true frogs found here, conducted without an intermission for four months, have yielded but little evidence that these creatures possess a particle of intelligence. It almost proved, indeed, to be labor lost, —

'To perch upon a slippery log,
And sit in judgment on a frog.'

[1] Animal intelligence. By George J. Romanes. (Internat. sc. series, no. xliv.) New York, *Appleton & Co.*

Mr. Romanes remarks, that, if frogs are removed to a long distance from water, they will take the shortest route to the nearest pool or brook. Even this, I find, is only usually true. Quite ten per cent of such 'removed' frogs started off, when released, in the direction of the most distant water, rather than that which was nearest. One of my many experiments was as follows: I placed a pail filled with water in a dry, dusty field, burying it to the brim. It was protected by a cap of coarse wire sieving. I then liberated a frog within twenty yards of it. It hopped in the opposite direction, towards water nearly three hundred yards distant. I then placed a frog on the opposite side of the buried pail, so that the distant brook could only be approached by passing near or directly over it, if the frog took a direct course. This the frog did, and less than a score of leaps brought it to the water covered by the sieve. It seemed quite satisfied with the fact that a little water was in sight, although out of reach. Here the frog remained until morning. The following day I removed the pail, and buried it within fifty yards of a running brook. I then took seven frogs of three species, and placed them upon the sieve, which was about half an inch above the surface of the water. Here five of them remained during the whole day, exposed to the glare and heat of a cloudless midsummer day. The evaporation from the water beneath them barely kept them alive; and yet within so short a distance was a running brook, with all the attractive features of ideal frog-life.

I repeated this experiment, with slight modifications, several times, and always with essentially the same results.

In his Travels in North America (Eng. trans., vol. ii. p. 171), Peter Kalm refers to certain habits of the bull-frog (Rana Catesbyana) which seemed to indicate that the frogs of this species occupying the same pond were somewhat governed by a leader. His remarks are, "When many of them croak together, they make an enormous noise. . . . They croak all together, then stop a little, and begin again. It seems as if they had a captain among them: for, when he begins to croak, all the others follow; and, when he stops, the others are silent;" and he adds that the 'captain' apparently gives a signal for them to stop. This, if true, would be evidence of considerable intelligence; but it is only apparently true of them. I have very carefully watched the bull-frogs in a pond near my house, and have found that the croaking of the 'captain' is not always that of the same individual. At times

the initial croak would come from one side of the pond, then the other, and so continue to vary. This shows at once that not any one individual started and stopped the croaking of its companions.

Hoping to find that in the pursuit of prey, which is principally insects, frogs would display some intelligence, I tried several experiments to test their ingenuity; but it was of no avail. Unless the food could be easily reached by making the simple exertion of a single leap, the frogs would go hungry. Subsequently I placed a large fly upon a piece of thin mica, and surrounded it with a circle of fine needles, piercing the plate. The fly thus protected could only be seized by the frog suffering a severe pricking of the jaws. This, I found, a frog would suffer indefinitely, in its attempts to secure the fly. In one instance, the frog, which had been fasting for seventy-two hours, continued to snap at the needle-protected fly until it had entirely skinned its upper jaw. I concluded from this, that the wits of a frog were too limited to be demonstrated.

Some weeks after having completed these experiments, I had the good fortune to capture two fully grown specimens of the bull-frog (Rana Catesbyana); and, noticing their enormously distended sides, I examined the stomach-contents of the two. In one was a full-grown chipmunk (Tamias striata); in the other, a garter-snake (Eutania sirtalis) measuring eighteen inches in length, and also a field-mouse (Arvicola riparia). On close examination, I found that the snake had partially swallowed the mouse; and, while thus helpless, the frog had evidently attacked the snake, and swallowed it.

It is evident, I think, that the frog recognized the helpless condition of the snake at the time, and took advantage of it. If so, it is evidence of a degree of intelligence, on the part of the frog, which the results of my experiments on the frogs generally, had not led me to expect. Certainly a frog, however large, will not attack even a small snake if it is possessed of its usual activity.

The salamanders, on the other hand, by their active movements, wandering disposition, quickness of hearing, and other minor characteristics, give evidence of greater intelligence. This I can state of them, however, as an impression only; for my efforts to prove them possessed of cunning were not successful. The purple salamander, it is true, fights when captured, curving its back, and snapping viciously. This no frog ever does. The common spotted triton (Diemyctelus) becomes quite tame when kept in an aquarium, and, as I found, is soon able to determine the difference between a fly held against the glass and one held over the water. I frequently held a fly against the glass, and very near the triton; but it took no notice of it, after one or two efforts to seize it, but would follow my hand, and, when the fly was held over the surface of the water, the triton promptly leaped at and seized it. This is, indeed, but meagre proof of intelligence, but seems to show, I think, that a salamander is more cunning than a frog.

My observations lead me to conclude, that the habits of an animal have much, if not all, to do with the intellectual capacity it possesses. Frogs, as a class, are not migratory. They frequent a given pond or stream; and, sustained by the insect-life that comes to them but is not sought, they pass an eventless life, trusting, as it were, to luck. Such an existence requires no intellectual exertion, and none is made. The salamanders, on the contrary, are far more wandering and active. They appear to be ever in search of food, and, when lying in wait for it, choose such positions as experience has taught them are best adapted for the purpose: at least, my studies of such specimens as I have kept in confinement lead me to believe so. Intellectually, therefore, the salamanders are in advance of the frogs; but the batrachians as a class, although higher in the scale of life than fishes, are, I believe, inferior to them in intelligence.

CHAS. C. ABBOTT, M.D.

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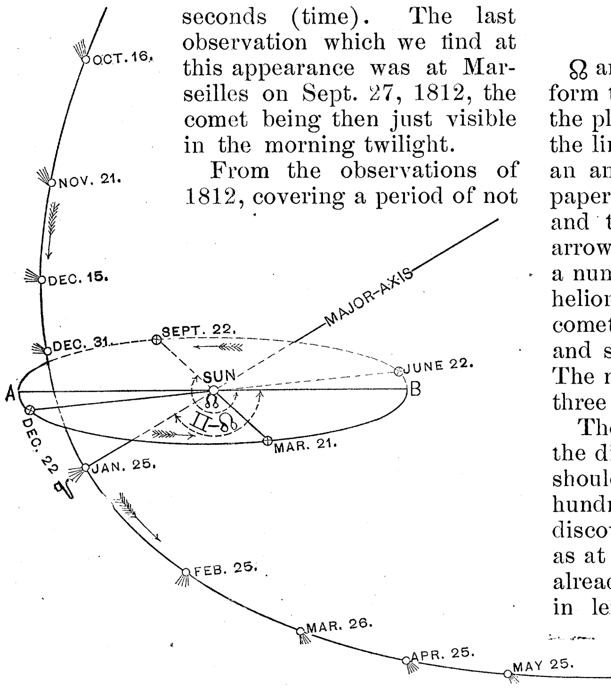
## *THE PONS-BROOKS COMET.*

THE comet which is now being observed at its first predicted return was discovered by Pons, at Marseilles, two hours after midnight of July 20, 1812. Pons was at the time *concierge* at the Marseilles observatory, but afterwards became its director. He died in Florence, Oct. 14, 1831, at the age of seventy, having, between the years 1801 and 1827, discovered no less than thirty-seven comets; this one, according to Zach (*Monatl. corr.*, xxvi. 270), the sixteenth in ten years.

Pons describes the comet at the time of discovery as an irregular, nebulous mass, without coma or tail, and invisible to the naked eye. Having made sure, from the motion, that it was really a comet, he announced his discovery on July 22; and, from July 25 to Aug. 3, it was bright enough to be observed, at lower culmination, with the Marseilles in-

struments. The comet seems to have been discovered independently at Paris by Bouvard, who describes it thus: "Cette comète était très petite. Elle ne fut visible à la simple vue que pendant quelques jours. Le 18 août son noyau, assez brillant, était entouré d'une nébulosité qui offrait l'apparence d'une chevelure et d'une queue d'environ 2° de longueur." Bode reports the comet visible to the naked eye on Sept. 9, 1812, and on Sept. 14 he gives the tail as 1° long; while on the same date, at Seeberg, the tail is given as 2° 17′, and the diameter of the nucleus 5.4 seconds (time). The last observation which we find at this appearance was at Marseilles on Sept. 27, 1812, the comet being then just visible in the morning twilight.

From the observations of 1812, covering a period of not quite ten weeks, several orbits were computed, that of Encke assigning a period of 70.68 years. More recently Messrs. Schulhof and Bossert, from an exhaustive discussion of all the observations available (including some not known to Encke), predicted a return to perihelion about September, 1884, though they pointed out that in their period there was an uncertainty of ±5 years. The comet was actually found by Brooks (Phelps, N.Y.) on Sept. 1, 1883, some time before it had reached the sweeping ephemeris of Schulhof and Bossert; but its identity was soon established.




PATH OF PONS-BROOKS COMET.

The annexed diagram will assist in forming an idea of the path in which the comet is moving. The earth's orbit (the northern side uppermost) is shown orthographically projected upon the plane of the comet's orbit. The data necessary for defining the ellipse in which the comet moves are, the angle ☊ (254°), the longitude of the ascending node; the angle Π − ☊ (−161°), the difference between the longitude of the node and the longitude of perihelion (Π); the angle $i$, the inclination between the earth's orbit and that of the comet; $q$, the perihelion distance (0.775) expressed in units of the earth's distance from the sun; $T$, the date of perihelion passage; and $e$, the eccentricity (0.96), or ratio, —

$$\frac{\text{distance from centre to focus}}{\text{semi-axis major}}.$$

☊ and Π − ☊ are shown in the figure; and, to form the complete picture, we are to imagine the plane of the comet's orbit revolved about the line $AB$, the line of nodes, until it makes an angle of 74° ($i$) with the plane of the paper. The directions in which the comet and the earth are moving are indicated by arrows. The positions of the two bodies on a number of dates are also given. The perihelion is reached on Jan. 25, 1884, when the comet is seventy million miles from the sun, and sixty-eight million miles from the earth. The nearest approach to the earth, about fifty-three million miles, is upon Jan. 8, 1884.

The brightness, as far as depending upon the distance from the sun and from the earth, should reach a maximum about Jan. 11, a hundred and forty-five times as bright as when discovered by Brooks, and five times as bright as at the time of Bode's observation, when, as already noted, the comet had a tail a degree in length. We might expect, then, that it would be visible to the naked eye from the middle of December to the middle of February, equalling, at its best, the brightness of a star of the third magnitude; but unusual and unexplained fluctuations in the brightness have been observed, which render these predictions a little untrustworthy. In the first week in December the comet passed within about seven degrees of the bright star $\alpha$ Lyrae, and continued its motion rapidly towards the south and east.

Since its discovery by Brooks, our visitor has behaved in a most peculiar manner as regards brightness. The theoretical change is given in Professor Boss's article in *Science*, ii. 449. On the following page we find observations made at Harvard college observatory on Sept. 21, 22, 23. The variability remarked at Harvard is confirmed by observations made at about the same time at Paris, Hamburg, and Dresden; so that we find a pretty well defined

maximum of from the seventh to the eighth magnitude, reached between Sept. 22 and 24, falling off suddenly on either side; for on Sept. 21 the comet was 'very faint,' with 'a slight condensation,' and on the 28th it was tenth to eleventh magnitude. Bigourdan says, "It had for some time a brilliancy thirty or forty times what might have been expected, — a fact difficult to explain on the theory that comets have no light of their own."

As regards any variability at its former appearance, the observations of 1812 are not sufficiently precise to furnish conclusive evidence.

A rough sketch of the comet, as seen with the 26-inch equatorial of the Naval observatory, Washington, was made on Sept. 26, 1883; and by permission of the superintendent of the observatory, Rear-Admiral R. W. Shufeldt, it is here given, with the observer's note. "Sept. 26.39, 1883; — observer, Winlock; —

PONS-BROOKS COMET, SEPT. 26, 1883.

26-inch equatorial, magnifying power 183. The comet appeared as an oval, nebulous mass, with a fairly well defined stellar nucleus, somewhat elongated in the *preceding following* direction, the nucleus being situated at about the centre of the nebulosity. The whole mass was some 6′ or 8′ in diameter."

The spectrum of the comet was examined by Konkoly,[1] Sept. 27, 1883. It consisted of three extremely faint bands, — the middle one brightest, the third (from the red end) next, and the one towards the red faintest. The bands ended in points, and were unequal in length. They sometimes lighted up for one or two seconds; and at these times they seemed to be much shorter than ordinarily, — a phenomenon quite new to the observer.

From the similarity of the orbits of the comets of 1812 and 1846, IV., Kirkwood has suggested (*Amer. journ. sc.*, 2d series, xlviii. 255) that they were doubtless members of a cometary system, and were brought into the solar system 695 years before the Christian era by the influence of Neptune. Schulhof and Bossert, in pointing out an error in Kirkwood's calculation, modifying somewhat his conclusion, say that the remarkable resemblance between the orbits of these comets indicates that there was originally some intimate connection between them. Indeed, these two comets, and the comets of 1815, 1847, V. (Brorsen), and 1852, IV. (Westphal), seem to belong to the same family.

As to the proper designation of this comet of Pons and of Brooks, authorities and precedents differ. In *The observatory* for November, 1883, Mr. W. T. Lynn writes, "I presume the designation Pons-Brooks's comet is understood to be only provisional. According to rule, it should be Pons's comet; . . . its permanent name must therefore be 'Pons's long-period comet,' or 'Pons's periodical comet of 1812.'" The shortest designation seems likely to prevail; and doubtless the comet will be known hereafter as the 'Pons-Brooks comet,' or perhaps simply as the 'Comet of 1812,' it being the only comet that was seen in that year.

W. C. WINLOCK.

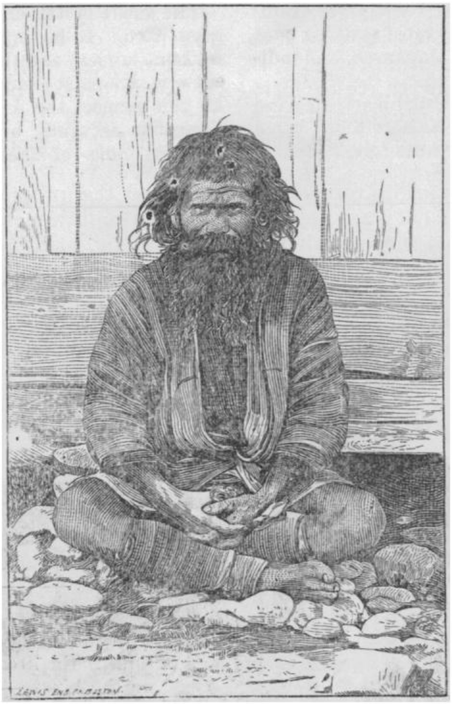
[1] *Astron. nachr.*, No. 2547. *The observatory*, November, 1883, 333.

## *THE AINOS OF YEZO.*[1]

ALTHOUGH the literature relating to the Island of Yezo, and the Ainos, — the inhabitants of this island as well as the southern half of Saghalien (or Karafuto), the Kurile Islands, and the southern extremity of Kamtchatka, — has increased much in recent years, still a description of the same, based upon personal observation, may be of use in explaining the many contradictory reports and opinions of ethnologists. Two facts should be borne in mind, — first, that the Ainos are not, even in the most remote way, to be classed with the dark races; and, second, that they are in no way related with their southern neighbors, the Japanese. With regard to their color, I must remark, that I have not found the Ainos of either sex darker than many Europeans: indeed, it is not rare to find in southern and eastern Europe darker individuals than are to be seen among the aborigines of Yezo. The assertion that the Ainos are dark brown, or even black, is sometimes made by those who do not take into consideration the fact that superstition prevents them from washing, and that consequently their complexion appears at times much darker than it really is. The real color, which may be best seen to advantage among the Ainos living on the seashore, is a little lighter, and less reddish, than that of the Japanese. The development of hair is somewhat remarkable: in the case of the men it covers the entire body to about the extent seen in very hairy Europeans. The beard is luxuriant and beautiful: the women imitate it by tattooing. The curly or wavy

[1] By Professor BRAUNS of Halle. Translated from the memoirs of the Berlin anthropological society.

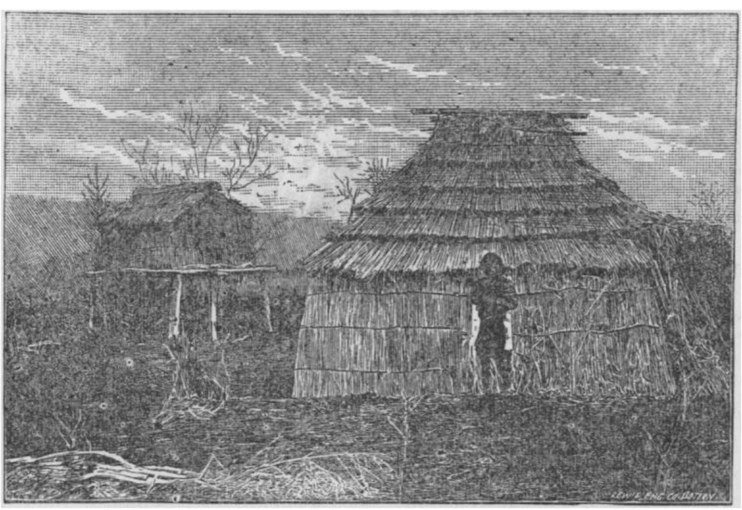
character of the hair of the head is quite striking. The physique is much better than that of the Japanese; the thigh is not so strikingly shortened; and the muscles are more strongly developed, while there is a weaker development of subcutaneous adipose tissue. The physiognomy and cranial conformation are also very different. The eyes are more deeply set than in the Japanese; and, as with us, they are shaded by heavy brows. The orbits, as shown by the skeleton of the face, are less high; and therefore the lids are horizontal, except in some hybrids. In contrast with the Japanese race, the forehead is straight; prognathism, when present, is very slight; and the nose and chin are generally well developed. The facial expression differs also from that of the Japanese: it indicates a certain fearlessness, joined with ingenuousness and a happy disposition. The intellectual characteristics correspond, as might be expected, to the impression produced by external features. As has often been noted, the generous and respectful hospitality of the Ainos never fails to make a more favorable impression on the traveller than is received among the Japanese. In the southwestern parts of the island the character changes somewhat under the influence of the dominant race; and here hybrids are quite numerous. The latter fact has doubtless given rise to erroneous opinions as to the affinities of the two races; for no one would assert a relationship of language, except travellers who knew nothing of the language of either race, and who regarded the Japanese language, which is spoken fluently by the Ainos, as the vernacular of the Ainos. All those who (as Dawidoff, Klaproth, Dobrotworsky, Pfizmaier, v. Siebold, Scheube, Batchelor, Miss Bird) have prepared larger or smaller Aino vocabularies have escaped this error.



AN AINO MAN.

These observations were forced upon me on my first acquaintance with the Ainos in and around Sapporo, where I learned to know, also, the Ainos that were brought from Saghalien to Yezo at the time the former island was ceded to Russia. My conclusions were further supplemented and confirmed through a festival instituted by the government of Sapporo (July 9, 1881), in order to show me, as they said, the earlier conditions of the island, as well as the products of modern civilization.

At one end of a large hall, in which we were seated, were seen a number of Saghalien Ainos regaling themselves with saké (rice-wine) under the mellow radiance of oriental lamps. Upon a signal to begin, a young man arose, and led on the women to a round dance, while the older men remained seated. The women, with their faces turned toward the centre of the circle, alternately prostrated themselves and arose, at the same time festively moving onward in the circle. Picturesque as was their costume, consisting of long robes made from the bast of the elm, and metal girdles on which hung carved knife or sickle scabbards, this dance was

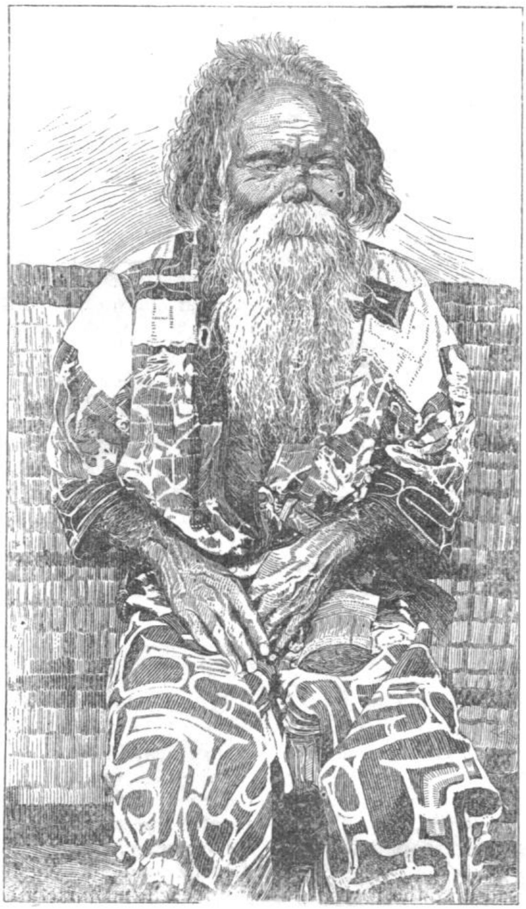


AINO HUT.

of inconsiderable interest, in comparison to the soft, melancholy, but melodious music, with its perfect time, which accompanied it. This singing would not have surprised me in the least in Norway, for example; but here it appeared in the most striking contrast with similar efforts of the Japanese, and indicated quite a different cast of mind.

In the vicinity of Sapporo was Juishikari, an Aino village of especial interest. It was here that I came to know the construction of their huts (great squares with smaller additions, all hung with rushes and reeds), many of their customs, their touching adhesion to their old nature-worship, their worship of the sun by the *Inawo* (a sacred staff frilled with shavings pendent from its upper end, and placed in the eastern window of the hut), and their fear of the dead. Their food consists mainly of millet and salted salmon.

The intelligence of the Ainos is by no means small. They learn the Japanese language very easily, accustom themselves very readily to all innovations which are not in conflict with their religious conceptions, occasionally make improvements, and are ready to answer questions in a precise manner. They never betray their age, and pretend not to know it. With this exception, I learned every thing I wished from them. I obtained, for example, a detailed account of their terms for different colors. After what I had seen, I was not surprised to find that these terms quite conformed to our own, and deviated fundamentally from those of the Japanese. The Japanese have only one word for *blue* and *green;* while the Ainos have distinct names for both colors, which often appear to be confounded when interpreted by the Japanese.



AN OLD AINO.

In Saru (or Sara) I had an opportunity to see all of an ancient state organization that has survived the introduction of a village government. Here I found the seat of the chief among the village elders, which was formerly located somewhat farther in the interior, at Biratori or Piratoru. The chief was regarded by the Ainos as a sort of king. Under Japanese domination his power and rank were lost.

The mode of travelling has been well described by Miss Bird. It is impossible to make any progress without horses; and these, although not of the meanest sort, are most shamefully abused by the Japanese. In this respect the Ainos generally prove useful and agreeable servants, but they are often the too subservient tools of their masters. However, I have never seen the Ainos abuse their horses, their only domestic animals, in the reckless and brutal manner observed among the Japanese: indeed, I have witnessed on many occasions quite the opposite mode of treatment.

In my journeys along the coast, I became convinced that the population of the Ainos had been under-estimated, just as that of the Japanese had been over-estimated. While the number of the latter is certainly less than a hundred thousand, instead of more, as officially reported, the number of the Ainos (said to be eighteen thousand) must be trebled in order to reach approximately accurate figures. The erroneous estimate of the Japanese government is explained by the fact that it takes no account of the large number of Aino villages on the large rivers of remote parts of the island, and particularly along the coast, but is based on the relation of the square surfaces of known and unknown parts. In some of the better known parts of the island, especially in the south-west, the Ainos have been completely dislodged; and in the mixed districts their number has also been much reduced.

From all these observations, as well as from the traditions of the Ainos, in which are ever-recurring laments for a better past, and from many peculiarities in their customs (e.g., loss of the use of really good weapons, the poisoning of the arrows and snares for beasts of the chase, particularly bears), we must conclude that the Ainos are to be classed with those peoples that have earlier been more richly supplied

with the implements of civilization, but have become degraded intellectually through isolation. Prehistoric discoveries, particularly those made in the region of Otaru, on the west coast of the island, favor this view. The pits found there for dwellings indicate that the Ainos came from the north to Yezo. The shell-heaps contain, besides very elegant potsherds, many stone implements, especially obsidian heads of lances and arrows, and ornaments of different kinds, as stone-beads and the like. In all these respects the shell-heaps are distinguished from those found throughout Japan, from latitude 39° north to the southernmost point of the coast of Kiushiu, within which limits the shell-heaps are destitute of ornaments, poor in stone implements, and entirely without obsidian. These facts point to a higher civilization of the Aino race, and at the same time refute the assumption that the Ainos formerly settled a large part of the main island (Nipon), — an assumption erroneously supposed by some to be supported by prehistoric discoveries. As there is no near relationship between the Ainos and the Giljaks of North Saghalien, who are less hairy, more prognathous, and more like the Tchuktchi race, we must assume that the Ainos were displaced by the Giljaks, and that their nearest relatives, judging from important analogies of language, and especially from their 'naturell,' are to be sought among the Kaoli of northern Corea (Oppert's Caucasian type of Koreans). The latter have symmetrical features and luxuriant beards, and are therefore called 'bearded barbarians' by the Japanese. They stand to the inhabitants of southern Corea in many respects as the Ainos to the Japanese. The Kaoli have had, to be sure, a history very different from that of the Ainos; for they became a civilized people, while the Ainos in the primeval forests of Yezo became more and more uncivilized. This fact is not opposed to the assumption of a kinship of the two races; and this assumption is supported not only by the particulars already alluded to, and the undeniable capacity of the Ainos for greater intellectual activity than they now exhibit, but also by the fact, that, notwithstanding the developed culture of the Coreans, certain things (e.g., the lance-shaped turrets on grave monuments) recur which remind one of Yezo. Besides, the traditions of the Kaoli, and certain names of places in the southern part of Amur (on the Sungari and its south-eastern tributaries), point to earlier dwelling-places of the race. From here the Ainos probably spread over the lower part of Amur and Saghalien. Other attempts to bring the Ainos and the North-Coreans into close relationship with other peoples are too hypothetical to require mention here. It is certainly to be hoped, but unfortunately it can hardly be expected, that the silent but eloquent appeal for friendly sympathy which the hearty greeting of the Ainos and the melancholy look given to strangers seem to make clear, may meet with some practical response: at all events, we should not withhold our most cordial good will from these sons of the primeval forests of our temperate zone, who are unquestionably the most peaceful and good-natured of all the so-called 'savages.'

## *THE HOT BLAST IN MAKING IRON.*

At the last few meetings of the Iron and steel institute of Great Britain very important papers have been presented and discussed, showing the direction in which competition has brought about economy in iron-manufacture. These papers, notably those of Messrs. Cochrane, Hawdon, Bell, Cowper, and Howson, give to the technical reader a very good idea of the latest opinions of the foremost iron-makers of England.

The institute held its September meeting in Middlesborough, — the place in which it was organized fourteen years ago. This anniversary naturally led to some general reflections on the progress made in that time, which can be appreciated by the general public. The only drawback to the discussions was the absence, owing to illness, of Mr. I. Lowthian Bell, who has been present at all the previous meetings.

In 1828 Mr. J. B. Neilson patented a process for heating the air before it was blown into the blast-furnace, claiming that a gain in economy of working was the result. The idea was received with disbelief in most quarters. A little later Mr. Neilson proved conclusively to all that one hundred pounds of coal burned in heating the air for the blast were able to save three hundred to four hundred pounds of the fuel used within the furnace. The first step was made, and the iron-makers had to accept the consequences.

From this small beginning the tide of invention and enterprise went on, until the air used for blast was no longer heated by coal burned for the purpose, but by the combustion of what were formerly waste gases issuing from the top of the furnace. One improvement after another was introduced, until the temperature of the blast was raised to 900° F., and even to 1000° F. At this point it seemed that the metal pipes used in the stoves for heating had reached their limit of endurance; and a portion of the iron-making world made up their minds that greater heat than this could not be economically maintained, and that, even if the question of obtaining the heat was solved, there was still a balance of chemical reactions within the furnace which would prevent the greater heat from being advantageous.

Meanwhile, by the use of the Siemens regenerator principle, two different inventors, Cowper and Whitwell, each manufactured stoves which contained fire-brick chambers, within which the waste gases burned for a period, until the fire-bricks were at a red heat. The gases were then turned off to the alternate stove, and the air for the blast-furnace was driven in through the heated stove until the other one had become sufficiently heated. The interchange was again made, and so on. These various devices have resulted in the production of a blast of air for the furnace heated up to 1600° F., or even to 1700° F.

Now let us see what has been the result of this change. The blast-furnaces of 1869 produced, on an average, a little over 180 tons of iron per week. To-

day they produce, on an average, upwards of 300 tons per week, in some cases 800 or 900 (and in one of the Pittsburg furnaces the enormous output of 1,800 tons has been reached). Mr. Charles Cochrane, an advocate of the hottest hot blast, stated, that, at the works at Ormsby, they began in 1855 with a furnace of 7,000 cubic feet capacity, and with a temperature of air between that of molten lead and molten zinc, using 39.64 cwts. of coke to the ton of pig. In 1857 they used 33.87 cwts.; in 1867 it was only 29.66; in 1877 it had become reduced to 22.64; and in 1882, 21.18 cwts. was the average for all furnaces, small and large, while the larger furnace of 34,000 cubic feet capacity worked the whole year through on 19.38 cwts. per ton of pig. Hence from 1855 to 1883 the saving was 20.34 cwts. of coke per ton of iron; and, in Mr. Cochrane's opinion, fully half this saving was due to the use of the Cowper fire-brick stoves.

Mr. Cochrane has recounted some of the theoretical calculations that have been made. In 1879 he ventured to predict that a ton of iron could be made with 17.90 cwts. In 1881 he had made iron with 18.40 cwts. Another iron-master stated that a furnace has run for eight weeks on less than 18 cwts.

Mr. Hawdon claims that heating the blast from 990° F. to 1400° F. resulted in a saving of 1.5 cwts. of coke to the ton of iron, and that a further heating to 1550° F. was followed by a total saving of 2.5 cwts., bringing the coke down to 21.3 cwts.

In the discussions which took place at the meetings referred to, the prominent iron-manufacturers generally took the ground that the hotter the blast the better the result, up to the temperature of melting iron. Mr. I. Lowthian Bell, however, dissents from this view, and thinks, that, in real ultimate economy, 1000° F. will prove to be about the limit of heat for the blast which it is worth while to strive for.

R. H. RICHARDS.

## *MODERN PHYSIOLOGICAL LABORATORIES: WHAT THEY ARE AND WHY THEY ARE.*[1] — I.

A LITTLE more than seven years ago I announced from this platform that the old biological laboratory was ready for use, — that set of rooms in the third story of this building, which, inconvenient in many respects as they were, will, I trust, always be remembered by some of us with affection, and mayhap with a little pride.

This night on which we have met to celebrate the completion of the new laboratory is, however, an occasion for looking forward rather than backward. But before proceeding to speak in detail of the new building, I feel sure I do but what every one of the members of the biological department present would think me remiss to omit, in pausing a moment to express our gratitude to those to whom we owe it, — first to our founder, Johns Hopkins, for his munificence; and next to his trustees. Probably very few present realize how much time and thought the trustees spent on the building before a stone of its foundation was laid, and during its erection. No one but myself knows how often I have been put in good heart by the cheering words, "Well, Dr. Martin, let us get it right when we are about it." In this connection I cannot refrain from saying, that, though we owe all so much, we owe a special debt of gratitude to Mr. Hall Pleasants, the chairman of the building committee. Throughout the whole summer there was hardly a morning on which he did not visit the building, and that not merely for a glance, but far more often to spend an hour or two hours about it, and make sure that all was going right.

The material result of this liberality, forethought, supervision, and care, is that stately building on the top of the hill. Handsome though not ostentatious, comfortable but not luxurious, pleasant to work in without unnecessary finery, it stands there, for its purpose unrivalled in the United States, and not surpassed in the world.

Substantial, solid, well thought out, suited to its ends, and with no frippery about it, it is now for us to see that our work agrees in character with the building.

There are many here to-night, who, not being biologists, may desire to know what such laboratories are for, and why there is any need of them. I shall perhaps best begin my attempt to answer these questions by stating briefly what our own laboratory is.

It is a building constructed primarily to afford facilities for instruction and research in physiology; and, secondarily, similar opportunities in allied sciences, as comparative anatomy and botany, some training in which is essential (and the more the better) to every one who would attain any real knowledge of physiology. As so many distinct branches of biological science are pursued in it, we call it in general the biological laboratory; but it is a biological laboratory deliberately planned that physiology in it shall be queen, and the rest her handmaids. If, therefore, you visit the building prepared to see a great zoölogical museum or an extensive herbarium, you will be disappointed. I do not underrate, and no one connected with this university can, — bearing in mind the brilliant anatomical researches of Dr. Brooks and others, made among us, — the claims of morphology; and in time I trust we may see a sister building specially designed for study of the structure, forms, and development of plants and animals. But one or the other had to be first chosen, unless we were to do two things imperfectly instead of one well, and there were strong reasons for selecting physiology. In the first place, I think even the morphologists will admit that hitherto, and especially in the United States, they have had rather more than their fair share; innumerable museums and many laboratories have been built for their use; while physiology, if she got any thing, was usually allotted some out-of-the-way room in an entirely unsuitable building, if

[1] An address delivered on the occasion of the formal opening of the new biological laboratory of the Johns Hopkins university, Jan. 2, 1884. By H. NEWELL MARTIN, M.D., Dr. Sc., M.A., professor of biology in the university.

no one else wanted it, and was very glad to get even that. A second and still stronger reason is, that as medicine is slowly passing out of the regions of empiricism and rule-of-thumb treatment, or mal-treatment, it has become evident that sound physiology is its foundation; and this university will at no distant day have a medical school connected with it.

As you walk presently through the rooms of the new building, and see the abundance of instruments of precision for teaching and research — the batteries, galvanometers, induction-coils, and spectroscopes; the balances, reagents, and other appliances of a chemical laboratory; the microscope for every student; the library of biological books and journals; the photographic appliances; the workshop for the construction and repair of instruments — when you see these things, it may interest you to recall that sixty years ago there was not a single public physiological laboratory in the world; nor was there then, even in any medical school, a special professor of physiology. So late as 1856 Johannes Müller taught in Berlin, human anatomy, comparative anatomy, pathological anatomy, physiology, and embryology.

DuBois-Reymond, now himself professor in Berlin, has graphically described the difficulties of the earnest student of physiology, when he attended Müller's lectures in 1840.[1]

"We were shown (he says) a few freshly prepared microscopic specimens (the art of putting up permanent preparations being still unknown), and the circulation of the blood in the frog's web." So much for the histological side.

"We were also shown the experiment of filtering frog's blood to get a colorless clot, an experiment on the roots of the spinal nerves, some reflex movements in a frog, and that opium-poisoning was not conducted along the nerves. There were some better experiments on the physiology of voice, — a subject on which Müller had recently been working; and there was finally a demonstration of the effect upon respiration of dividing the pneumogastric nerves."

In all, you see six experiments, or sets of experiments, in the whole course, in addition to the exhibition of some microscope slides; and all these mere demonstrations. It was hardly thought of, that a student should use a microscope, or make an experiment, himself. If he desired to do so, the difficulties in his way were such as but few overcame.

"He must experiment in his lodgings, where on account of his frogs he usually got into trouble with the landlady, and where many researches were impossible — there were no trained assistants to guide him — no public physiological library — no collection of apparatus. We had to roll our own coils, solder our own galvanic elements, make even our own rubber tubing, for at that time it was not an article of commerce. We sawed, planed and drilled — we filed, turned, and polished. If through the kindness of a teacher a piece of apparatus was lent to us, how we made the most of it — how we studied its idiosyncrasies — above all, how we kept it clean!"

Of course certain men, the men who were born to become physiologists, and not mere attendants on lectures on physiology, surmounted these difficulties. One has only to recall the names of DuBois-Reymond himself, and of such of his contemporaries as Brücke, Helmholtz, Ludwig, Vierordt, Donders, and Claude Bernard, to realize that fact; and undoubtedly there was a good side to it all. Triflers, at any rate, were eliminated; and the class of individuals was unknown who sometimes turn up at modern laboratories (and, judging from a good deal of current physiological literature, sometimes get admitted to them) with a burning desire to undertake forthwith a complicated research, though they would hardly know an ordinary physiological instrument if shown to them, much less how to handle it. They never can wait: they must begin the next morning, believing, I presume, that modern laboratories are stocked with automatic apparatus, — some sort of physiological sausage-machines, in which you put an animal at one end, turn the handle, and get a valuable discovery out at the other.

With one exception, Berlin was not in 1840 worse off than other German universities, so far as facilities for physiological study were concerned, and certainly better off than any university in England or the United States. The exception was in Breslau, where the celebrated Purkinje, single-handed, had founded a physiological institute. It has usually been supposed that in this he followed the example given by Liebig, who founded at Giessen the first public chemical laboratory; but this, *pace* my colleague Professor Remsen, can hardly have been the case. It is to Purkinje that the honor belongs of founding the first public laboratory. Liebig undoubtedly conceived the plan when working in Paris in Gey Lussac's private laboratory, but it was not until 1826 that he began to put it into execution; and at that date Purkinje had already, largely at his own cost, started a physiological laboratory at Breslau, open to students, — on a very small scale, it is true, but still the germ of all those great laboratories of physics, chemistry, and biology, which are now found in every civilized country, and to which, more than to any thing else, modern science owes its rapid progress. Of these there must be at least forty now organized for physiological work; and almost every year sees an increase in their number. How has this come about in the fifty odd years which have passed since the origination of Purkinje's ill-equipped and little known workrooms?

First and foremost, because of the improvement in philosophy which took place as men began to break loose from the trammels of Greek and mediaeval metaphysics, and to realize that a process is not explained by the arbitrary assumption of some hypothetical cause invented to account for it. So long as the phenomena exhibited by living things were regarded, not as manifestations of the properties of the kind of matter of which they were composed, but as mere exhibitions of the activity of an extrinsic independent entity, — a pneuma, anima, vital spirit, or vital principle which had temporarily taken up its residence in the body of an animal, but had no more essential connection with that body than a tenant with the house in which he lives, — there was no need for physiological laboratories. Dissection of the dead body might, indeed, be interesting as making known

[1] Emil DuBois-Reymond. *Der physiologische unterricht, sonst und jetzt.* Berlin, 1878. The quotations from this pamphlet, while giving, I trust, a true idea of the substance of DuBois-Reymond's statements, have been curtailed, and are not to be regarded as literal full translations of the original. — H. N. M.

the sort of machine through which the vital force worked, — just as some people find it amusing to visit the former abode of a great author, and see his library and writing-table and inkstand; and there might be discussions as to the locality of the body in which this vital force resided; to carry out our simile, as to what was its favorite armchair. Various guessers placed it in the heart, the lungs, the blood, the brain, and so forth. Paracelsus, with more show of reason, located it in close connection with the stomach, on the top of which he supposed there was seated a chief vital spirit, Archaeus, who superintended digestion. It is mainly to Descartes,[1] who lived in the earlier half of the seventeenth century, that physiology owes the impulse which set it free from such will-o'-the-wisps. Putting aside all consciousness as the function of the soul, he maintained that all other vital phenomena were due to properties of the material of which the body is composed; and that death was not due to any defect of the soul, but to some important alteration or degeneration in some part or parts of the body.

The influence of Descartes, and in the same half-century the demonstration of the circulation of the blood by Harvey, gave a great impulse to experimental physiology. Both Harvey and Descartes, however, still believed in a special locally placed vital spirit or vital *force*, which animated the whole bodily frame as the engine in a great factory moves all the machinery in it. What a muscle did, or a gland did, depended on the structure and properties of the muscle or gland; but the work-power was derived from a force outside those organs, — on vital spirits supplied from the brain along the nerves, or carried to every part in the blood. As the pattern of a carpet will depend on the structure and arrangement of the loom, — which loom, however, is worked by a distant steam-engine, — so the results of muscular or glandular activity were believed to be determined by the structure of muscle and gland; but the moving-force came from some other part of the body.

The next essential advance was made by Haller, about the middle of the eighteenth century. He demonstrated that the contracting-power of a muscle did not depend on vital spirits carried to it in nerve or blood, but on properties of the muscle itself. Others had guessed, Haller proved, that the body of one of the higher animals is not a collection of machines worked by a central motor, but a collection of machines each of which in itself is both steam-engine and loom; leaving aside, of course, certain of the purely mechanical supporting and protecting apparatuses of the skeleton. This was the death-blow of the 'vital force' doctrine. Extensions of Haller's method showed that it was possible to destroy the brain and spinal cord of an animal, and separate its muscles, its heart, its nerves, its glands, and yet keep all these isolated organs working as in life for many hours. The life of an animal could be no longer regarded as an entity residing in one region of the body, from which it animated the rest; and the word gradually became simply a convenient phrase for expressing the totality or *resultant* of the lives of the individual organs. Physiologists began to see that they had nothing to do with seeking a vital force, or with essences or absolutes; that their business was to study the phenomena exhibited by living things, and leave the noumena, if there were such, to amuse metaphysicians. Physiology thenceforth became more and more a study of the mechanics, physics, and chemistry of living organisms and parts of organisms.

Progress at first was necessarily very slow; physics and chemistry, as we now know them, did not exist; galvanism was not discovered; osmosis was unknown; the conservation of energy was undreamed of; while modern chemistry did not take its rise until the discovery of oxygen by Priestly, and the extension and application of that discovery by Lavoisier towards the close of the last century. Physiology had to wait then, as now, for its advance upon the development of the sciences, dealing with simpler forms of matter than those found in living things. But little by little, step after step, so many once mysterious vital processes have been explained as merely special illustrations of general, physical, and chemical laws, that now the physiologist scans each advance in these sciences in full confidence that it will enable him to add another to the phenomena of living bodies, which are in ultimate analysis not peculiar or 'vital,' but simply physico-chemical. Apart from the phenomena of mind, whose mysterious connection with forms of matter he can never hope to explain, if a modern physiologist were asked what is the object of his science, he would answer, "not the discovery or the localization of a vital force, but the study of the quantity of oxidizable food taken into the stomach, and the quantity of oxygen absorbed in the lungs; the calculation of the energy or force liberated by the combination of the food and oxygen; and observation of the way in which that force has been expended, and the means by which its distribution may be influenced."

Once it was recognized that at least the great majority of physiological problems were problems admitting of experimental investigation, the necessity for special collections of apparatus suitable for experiment on living plants and animals, and for affording students an opportunity to study the play of forces in living organisms, had not long to wait for recognition. Physiological laboratories were organized at first in such rooms as could be spared in buildings constructed for other purposes; later, in structures built for this special end. The first laboratory specially erected for physiological work was built for Vierordt, in Tübingen, less than twenty years ago. So far as I know, our own is the first such building in the United States.

There is still another reason which has combined with the recognition of the independence of physiology as a science to make the modern laboratory, open to all properly prepared students, a possibility; and physiology owes it to this country. I do not forget how Brown-Sequard in Philadelphia clinched and completed Bernard's great discovery of the vaso-motor

[1] See Huxley: *The connection of the biological sciences with medicine* (*The lancet*, Aug. 13, 1881).

nerves; nor the researches of Weir Mitchell on the functions of nerve-centres, and the action of snake-poisons; nor, in later years, the researches of Wood on the physiology of fever; and on various subjects by Bowditch, Arnold, Flint, Minot, Sewall, Ott, Chittenden, Prudden, Keyt, and others. But speaking with all the diffidence which one, who, at least by birth, is a foreigner, must feel in expressing such an opinion, I say, that considering the accumulated wealth of this country, the energy which throbs through it, and the number of its medical schools, it has not done its fair share in advancing physiological knowledge, *but for one thing*, which makes the world its debtor. I mean the discovery of anaesthetics. When Morton, in 1846, demonstrated in the Massachusetts general hospital that the inhalation of ether could produce complete insensibility to pain, he laid the foundation-stone of our laboratory, and of many others. No doubt the men whose instincts led them to physiological research, and who realized that by the infliction of temporary pain on a few of the lower animals they were discovering truths which would lead to alleviation of suffering, and prolongation of life, not only in countless generations of such animals themselves, but in men and women to the end of time, would have tried to do their work in any case. But the men who can steel their hearts to inflict present pain for a future greater gain are few in number. The discovery of anaesthetics has not only led to ten physiological experimenters for each one who would have worked without them, but by making it possible to introduce into the regular course of physiological teaching, demonstrations and experiments on living animals, without shocking the moral sense of students or of the community at large, has contributed incalculably to the progress of physiology.

On the occasion of the opening of the old laboratory I used these words:[1] —

"Physiology is concerned with the phenomena going on in living things, and vital phenomena cannot be observed in dead bodies; and from what I have said you will have gathered that I intend to employ vivisections in teaching. I want, however, to say, once for all, that here, for teaching purposes, no painful experiment will be performed. Fortunately the vast majority of physiological experiments can nowadays be performed without the infliction of pain, either by the administration of some of the many anaesthetics known, or by previous removal of parts of the central nervous system; and such experiments only will be used here for teaching. With regard to physiological research, the case is different. Happily here, too, the number of necessarily painful experiments is very small indeed; but in any case where the furtherance of physiological knowledge is at stake — where the progress of that science is concerned, on which all medicine is based, so far as it is not a mere empiricism — I cannot doubt that we have a right to inflict suffering upon the lower animals, always provided that it be reduced to the minimum possible, and that none but competent persons be allowed to undertake such experiments."

Those words were a declaration of principle and a pledge given to this community, in which I was about to commence my work. That the work has been carried on for seven years among you, without a murmur of objection reaching my ears, is sufficient proof that Baltimore assents to the principle; and, gratifying as the building of our new laboratory is to me from many points of view, there is none so grateful as its witness, that, in the opinion of our trustees and of my fellow-citizens, I have carried out my pledge. There has been no hole-and-corner secrecy about the matter: the students in the laboratory have been no clique living isolated in a college-building, but either your own sons, or boarders scattered among dozens of families in this city; and no room in the laboratory has ever been closed to any student: what we have done has been open to all who cared to know. On this occasion, when we formally make a fresh start, I desire to re-assert the principle, and repeat the pledge.

[1] *Pop. sc. monthly*, November, 1876.

(*To be concluded.*)

## *BERTHELOT'S EXPLOSIVE MATERIALS.*

*Explosive materials, a series of lectures delivered by* M. P. E. BERTHELOT; *translated by* MARCUS BENJAMIN. *A short historical sketch of gunpowder; translated from the German of* KARL BRAUN *by* Lieut. JOHN P. WISSER, U.S.A. *A bibliography of works on explosives; reprinted from Van Nostrand's magazine*, No. 70. N.Y., *Van Nostrand*, 1883. (Van Nostrand's science series.) 180 p. 24°.

THE lectures of Berthelot, which form the more important part of this collection, are devoted to a popular exposition and amplification of the theories which he has from time to time advanced, concerning the constitution and mode of action of explosive substances. The principal topics treated are, the force of explosives; the origin, duration, and speed of propagation of the explosive reactions; inflammation and detonation as modes of inducing explosions; and explosions by influence.

The force of an explosive may be understood in two ways: it may be considered either as the pressure developed or as the work accomplished. The pressure depends principally upon the nature of the gases formed, their volume, and their temperature. The work, on the other hand, is principally dependent upon the amount of heat given off in consequence of the chemical decomposition. In practice, as, for instance, in guns, the transformation of this heat into useful work is never complete, since heat is absorbed by the gun, gases, and projectile, and a portion of the work produced is lost in moving the gases and air projected. Taking all these facts into consideration, it has yet been difficult to explain the great differences which result from the different methods employed for inducing explosions. Berthelot holds that this diversity depends upon the rapidity with which the explosive reaction propagates itself, and the more or less intense pressures which result from it, and he illustrates it as follows: —

Let the case be the simplest one, such as an explosion caused by the fall of a weight from a certain height. At first one would suppose the effects observed to be due to the heat developed by the pressure of the suddenly arrested weight. But calculation shows that the arresting of a weight of several kilograms, falling .25 to .50 of a metre, would not be capable of raising the temperature of the explosive mass more than a fraction of a degree, if the resulting heat were dispersed uniformly throughout the entire mass; while for a body such as nitro-glycerine, for instance, it is necessary to heat it to 190° to induce explosion.

It is by another process that the mechanical energy of the weight, which is transformed into heat, becomes the originator of the observed effects. It is sufficient to assume, that, as the pressures which arise from the shock exerted on the surface of the nitro-glycerine are too rapid to become uniformly dispersed throughout the entire mass, the transformation takes place locally among the layers first reached by the shock. If it is sufficiently violent, they may thus be rapidly heated to the necessary temperature; and they will be immediately decomposed, and produce a large quantity of gas. This production of gas is in its turn so violent that the shocking body has not time to displace itself; and the sudden expansion of the gases of explosion produces a new shock, probably more violent than the first, on the layer situated below. The mechanical energy of this shock is changed into heat in the layers which it reaches, and produces an explosion; and this alternation between a shock developing mechanical energy which changes into heat, and a production of heat which elevates the temperature of the layers up to the degree necessary for a new explosion capable of reproducing the shock, propagates the reaction, molecule by molecule, through the entire mass. The propagation of the deflagration takes place in this way in consequence of phenomena comparable to those which produce a sonorous wave; that is to say, by producing a real explosion which advances with a rapidity incomparably greater than that of a simple burning provoked by the contact of a body in ignition, and operating under conditions where the gases expand freely in proportion to their production.

The reaction started by the first shock in a given explosive material is propagated with a rapidity which depends upon the intensity of the first shock; and this intensity may vary considerably, according to the method by which it is produced. Marcel Duprez has shown that the effect of a blow from a hammer may vary in duration from the hundredth to the ten-thousandth of a second, according as one strikes with a hammer having a flexible handle or with a block of steel. From this it follows that the explosion of a solid or liquid mass may develop itself according to an infinite number of different laws, each one of which is determined, all other things being equal, by the original impulse. The more violent the initial shock, the greater will the resulting violence of the decomposition be, and the greater will be the pressures which are exerted during the entire course of this decomposition. One and the same explosive substance may hence produce very different effects, according to the method of ignition.

Among these methods of ignition, by far the most curious and inexplicable is the determining of the explosion of one mass by the explosion of another mass near by, but not in contact with it, which is termed by Berthelot 'explosion by influence.' Abel has offered his theory of *synchronous vibrations* to explain this phenomenon, and the theory seemed to be confirmed by the interesting experiments of Champion and Pellet; but Berthelot regards them as inconclusive, or else directly opposed to Abel's theory, and he offers a theory of his own, which is but an expansion of that of shocks explained above.

Working, as Berthelot is, under the direct auspices of the French government, he has had the best of facilities for the study of explosive substances and the phenomena of explosions; and no one has probably engaged in a more critical or extended physical and chemical examination of these bodies, and hence he speaks with authority. Yet some of his theories have failed to find general acceptance, especially that concerning the influence of dissociation upon the force of explosives; and it is noticeable that this theory finds no place in these lectures.

Karl Braun's sketch is bright and entertaining but iconoclastic, and, while wresting the honor of the discovery of gunpowder from Berthold Schwartz, intimates that the knowledge of its manufacture was brought from the orient to Augsburg in 1353 by a Greek Jew named Typsiles.

Of the 'Bibliography of explosives' the best that can be said is, that it is an unsystematized collection of titles, that it is filled with errors of the grossest kind, and that it is unworthy of both compiler and publisher. In fact, it must be said the book throughout is marred by printers' errors.

## HOUSTON'S ELEMENTS OF CHEMISTRY.

*The elements of chemistry; for the use of schools, academies and colleges.* By EDWIN J. HOUSTON. Philadelphia, *Eldredge*, 1883. 444 p., illustr. 8°.

HOUSTON'S 'Elements of chemistry' is a brief compilation of the latest facts in regard to the science, arranged for the use of schools, academies, and colleges. Its use will be confined to the first named, or at least to institutions where the rudiments of chemistry are taught. The work is divided into three parts, — theoretical, descriptive or experimental, and organic, — and the arrangement is in most respects good. In the first part the fundamental laws are clearly and concisely stated, and present the subject in a form as well adapted to beginners as we have seen in any text-book. A short description of the different systems of crystallography concludes this portion. In the descriptive part the elements are discussed under the head of non-metals and metals in an order based upon their quantivalence; but the division of the metals into perissad and artiad is not one which most text-books follow. A brief outline is given, in the seventy-five pages of the third part, of the chemistry of the carbon compounds; and the author has succeeded in condensing into this space many important facts; there are, however, several erroneous statements and a general lack of completeness. The division of the carbon compounds into single link, double link, etc., is simply investing an old classification with a new name, and there is no gain in point of clearness.

A large portion of the book, nearly one-fourth, is repetition in the form of a syllabus and questions for review, at the end of each chapter, and, at the close of the book, questions for examination. This seems to be for the purpose of aid, in case the teacher should have had insufficient training in the subject. Indeed, so great is the help afforded, that with it any one with little or no knowledge of chemistry could assume the instruction of a class. We cannot but deplore the introduction of such a system of teaching at a time when it is all-important that chemistry should be scientifically taught in our elementary schools. Instruction in chemistry, to be thorough, should depend upon the teacher, and not upon the text-book. Only a good instructor can impress upon a beginner the necessity for observation, which is the prime requisite for successful work; and a text-book intended to be crammed tends to destroy the sense of observation. The space devoted to this system could have been profitably devoted to increasing the number of experiments and illustrations of experiments; which last are few and illy executed, and often do not show the best method of conducting the experiment. We object to the use of the Fahrenheit scale and English measures as causing a needless confusion, inasmuch as the centigrade scale and metric system are the accepted scientific notation.

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## BESANT'S HYDROMECHANICS.

*A treatise on hydromechanics. Part i., hydrostatics.* By W. H. BESANT, F.R.S., mathematical lecturer of St. John's college, Cambridge. 4th ed. *Deighton Bell & Co.*, 1883. 288 p. 8°.

THIS is "a reproduction, with considerable alterations and additions, of the first part of a treatise on hydrostatics and hydrokinetics, the third edition of which was published in 1877," and is intended as a text-book upon this subject, for those preparing for the mathematical tripos examinations at Cambridge, England. The principal heads treated are, the general conditions of fluid equilibrium; surfaces ot equal pressure; resultant pressures; the equilibrium, stability, and oscillations of a floating body (metacenter); the pressure of the atmosphere; the tension of flexible surfaces, and their relation to capillary phenomena; and, finally, the figure of equilibrium of a mass of rotating fluid, acted on by the mutual attraction of its parts. This work requires, as do most of the Cambridge mathematical text-books, that the reader shall have perfect facility in the employment of the differential and integral calculus. There is a plentiful list of examples, selected from previous examination papers, at the end of each chapter. It is perhaps superfluous to speak of the important place which the subject of hydromechanics has occupied in modern mathematical physics since the labors of Helmholtz, Maxwell, and Thomson, in reducing the mathematical treatment of electricity and magnetism to that of the motion of incompressible fluids. This volume is put forth as an introduction to the discussion of fluid motion or hydrokinetics, of which the elements will be given in part ii., which the author hopes to have in readiness early in 1884.

It is a matter of great regret that the state of mathematical training among our colleges is of such elementary character, that there are comparatively few of them where the excellent text-books of this grade can be profitably used by the undergraduates.

# RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

### American philosophical society.

The Proceedings of the society, vol. xxi., No. 114, from April to December, 1883, to be distributed to the members and correspondents of the society in January, contains: 1. A memoir on the migration of the Tutelo tribe of Indians, by Horatio Hale (with a map); 2. Medieval sermon-books, etc., by Prof. I. F. Crane of Cornell university; 3. The latitude of Haverford college, by Isaac Sharpless; 4. A crinoid with movable spines, by H. S. Williams (with a plate); 5. The *rôle* of parasitic photophytes, by W. N. Lockington; 6. The reversion of series, and its application to the solution of numerical equations, by J. G. Hagen, S.J.; 7. The conversion of chlorine into hydrochloric acid in the deposition of gold from its solutions by charcoal; 8. A brief account of the more important public collections of American archeology in the United States, by Henry Phillips, jun.; 9. Photodynamic notes, No. viii., by Pliny E. Chase; 10. Introduction to a study of the North-American Noctuidae, by A. R. Grote; 11. Revision of the Lysiopetalidae, by A. S. Packard, jun.; 12. The Perry county fault, by E. W. Claypole; 13. Seeds sprouting in ice, by Joseph Lesley; 14. A relic of the native flora of Pennsylvania, by E. W. Claypole; 15. The Portage rocks in Perry county, by the same; 16. The genus Rensselaeria, by the same; 17. A large Catskill crustacean, by the same (with a plate); 18. Obituary notice of Henry Seybert, by Monclure Robinson; 19. The zone of asteroids and ring of Saturn, by Daniel Kirkwood; 20. Obituary notice of Dr. John F. Meigs, by Dr. William Pepper; 21. Kintze's fire-damp indicator, by Charles A. Ashburner; 22. Obituary notice of Oswald Heer, by Leo Lesquereux; 23. Obituary notice of Dr. John L. LeConte, by Dr. George H. Horn; 24. Aerial ships, by Russell Thayer, C.E.; 25. Section of Chemung rocks at Le Roy, Bradford county, Penn., by A. T. Lilley; 26. Distribution of Loup Fork formation in New Mexico, by E. D. Cope; 27. Second addition to the knowledge of the Puerco epoch, by the same; 28. The trituberculate type of tooth in the mammalia, by the same; 29. Delaney's synchronous multiplex telegraph, by Edwin J. Houston; 30. The microscopic examination of timber with regard to its strength, by Frank M. Day (with a plate). Several papers requiring illustrations are left over to be published in No. 115, as it is the custom of the society to publish its two annual numbers of its proceedings as nearly on the 1st of January and June as possible. No. 114 includes pp. 1 to 350 of the current vol. xxi.

The society has also published, as part i. of vol. xvi. of its transactions, a Dictionary of Egyptian hieroglyphics, by Edward Y. McCauley, U.S.N. (240 p., 4°), printed from relief-plates photographed from Commodore McCauley's manuscript.

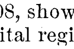
The society is printing the last pages of its library catalogue, the fourth and last part of which will be published in February or March. The whole catalogue (three parts of which have been distributed in previous years) will make about fifteen hundred pages octavo. There will be subsequently published an alphabetical index of author's names, and a supplement of books received since a certain date.

The society is also printing, as a volume of about five hundred pages octavo, a succinct transcript of its minutes from 1744 to 1837, made by the secretary in 1882. Its proceedings were first published in 1838, and subsequently in one series up to the current No. 114. The possible destruction of the minute-books, by fire or otherwise, has always been a cause of anxiety. When this volume from 1744 to 1837 is printed, a complete history of the society will be secured. Already proof-reading has reached p. 288 (minutes of 1800), and the volume will probably be published in May next.

### Cincinnati society of natural history.

*Jan. 8.* — Dr. Walter A. Dun read a paper on some recent explorations of mounds in the Scioto valley. The paper gave a detailed description of the mound, a large one, its dimensions being thirty-three feet in height, and a hundred and fifteen feet in diameter. The shaft sunk from the top showed several intrusive burials, and that the mound was constructed of successive layers of sand and clay. At the depth of twenty-five feet a vault constructed of logs was found, in which was a large quantity of root-like fibres, with a skeleton in a fair state of preservation. The skull was saved almost entire, and was described in detail by the doctor, who found it to compare closely with the figures of mound-builder skulls in Squier and Davis's 'Monuments,' and Morton's 'Crania americana.' A number of flint arrow-points, shell beads, and a small octagonal piece of sandstone, were also found in the 'vault.' The vault was eight feet high, five feet and a half long, and four feet wide.

The discovery of an authentic mound-builder's skull was regarded as important, and worthy of record. Dr. Dun also read a detailed description of the teeth and jaw of the skull, prepared at his request by Dr. E. G. Betty. Mr. Joseph F. James remarked that a skull found near Memphis, Tenn., associated with some earthen pots bearing dates of 1654–1708, showed the same remarkable flattening of the occipital region shown in Dr. Dun's specimen.

Mr. J. R. Skinner said that he had lately observed that the symbol of the Aztec god, Itzcoatl (), was the same as a marking upon what is known as the Richardson tablet from Wilmington, O.

### Society of arts, Massachusetts institute of technology.

*Dec. 27.* — Mr. John Ritchie, jun., exhibited and explained a model showing the orbit of the comet of 1812, and Mr. J. R. Robinson described his safety-seam steam-boiler. Mr. Robinson's first invention consisted in reaming out the edges of the rivet-holes in the plates on the inside, or where they come in contact, making them conical for a short distance.

When the rivet is put in, it flows out and fills the space thus formed, becoming, therefore, of greater diameter at the middle than at the ends. When the plates are under tension, the rivet will cant, and the ring-like projection around its centre will pry the plates slightly apart, as Mr. Robinson has satisfactorily demonstrated by experiment, thus allowing the escape of the steam in the case of a boiler, and avoiding an explosion; while, on the removal of the stress, the plates come tightly together again, provided the strain on the rivet were adapted not to exceed its elastic limit. The simple conical reaming-out of the holes, however, was not found to be just what was wanted; as it was possible for the metal of the rivet to be forced out between the plates farther than was wished, preventing their coming together tightly at all, even at first. To obviate this objection was the object of Mr. Robinson's second invention, which consists in cutting out a small hemispherical ring in each plate around the rivet-hole, and reaming out to this ring, so that when the plates are put together the conical enlargement of the hole at the centre is followed by a chamber in the shape of a circular ring; and into this 'relief-chamber' the metal of the rivet can flow out. But, as the amount of metal to be so forced out is never to be great enough to fill this chamber, the plates are brought closely together in the process of riveting, while the action of the rivet under great pressures is the same as has been described.

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## *INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.*

### GOVERNMENT ORGANIZATIONS.

#### Geological survey.

*Geology.* — Prof. L. C. Johnson reports that the Ripley group of the cretaceous in Alabama and Mississippi presents some curious and interesting features. It is an interrupted formation. Beginning in Mississippi, north-west of the Corinth group, it runs southward one hundred miles, and there runs out. It also appears in the extreme south-east, on the Chattahoochee River, in Barbour county, Ala., and extends westward to a point undetermined, but not reaching the Alabama River. It also occurs as a wedge between the elder cretaceous and the great lignitic A.

*Chemistry.* — The chemical division of the survey is at work on analyses of alkaline and saline waters from the Great Basin, collected by Mr. G. K. Gilbert and I. C. Russell; notably, the waters of Humboldt River, Walker Lake, Pyramid Lake, Mono Lake, Lake Tahoe, etc. There are also on hand, awaiting analysis, specimens of water from Helena hot-springs, Montana, from warm springs of Emigrant Gulch and from Livingston, in the Yellowstone valley, in Montana, collected by Dr. A. C. Peale during the past summer.

Prof. F. W. Clarke is also engaged upon a complete revision of his specific-gravity tables, which form part i. of the Smithsonian Constants of nature.

A white porcelain-like clay from the Detroit coppermine, near Mono Lake, California, proves, upon analysis by Professor Clarke, to be a very pure halloysite, thus adding another to the list of localities for this mineral.

A mineral sent in from Big Springs, Texas, said to occur there in abundance, proves to be a mixture of gypsum and sulphur, the latter predominating.

*Miscellaneous.* — The topographical parties have all returned to the office in Washington. The total area surveyed during the season amounts to fifty-one thousand square miles.

Early in September, while attempting the ascent of the 'Three Sisters,' a group of peaks in the Cascade range in Oregon, Ensign Hayden, who accompanied Mr. J. S. Diller in his reconnaissance of the Cascade range, was thrown from the edge of a cliff by the crumbling of the rocks, and seriously injured. As a result of the accident, he has recently had to suffer an amputation of one of his legs. The operation was performed at Portland, Or. Mr. Diller, in rescuing Mr. Hayden, was also hurt, but not seriously, by the falling rocks.

The library of the survey has just secured a copy of the 'Codex Cortesianus,' by Léon de Rosny, of which eighty copies have just been published in Paris (1883). The line of Mexican manuscripts for the study of the Maya alphabet, in the library of the survey, is now complete, with the exception of a manuscript in the possession of Señor D. Alfredo Chavero, in the city of Mexico. It is entitled 'A MS. explanation in Italian of the Codex Borgiana, by Fabregat.' Steps are being taken to secure a copy of it for publication.

The manuscript for two survey bulletins has been sent to the government printer: viz., No. 3, 'On the fossil faunas of the upper Devonian, along the meridian of 76° 30′, from Tompkins county, N.Y., to Bradford county, Penn.,' by H. S. Williams; and No. 4, 'Lists of elevations,' by Henry Gannett.

Five volumes of the monographic publications of the Hayden survey are still unpublished. The general direction of the completion and publication of these quarto reports has been put in charge of the director of the geological survey. Two of these volumes are almost wholly in type, and will be issued shortly.

The London *Graphic* of Nov. 17 has a double-page illustration of the Transept in the Kaibab Grand Cañon of Colorado River, which is an engraving reduced from plate xviii. of the atlas accompanying Capt. Dutton's 'Tertiary history of the Grand Cañon' (vol. ii. of the monographs of the survey).

### PUBLIC AND PRIVATE INSTITUTIONS.

#### Massachusetts institute of technology.

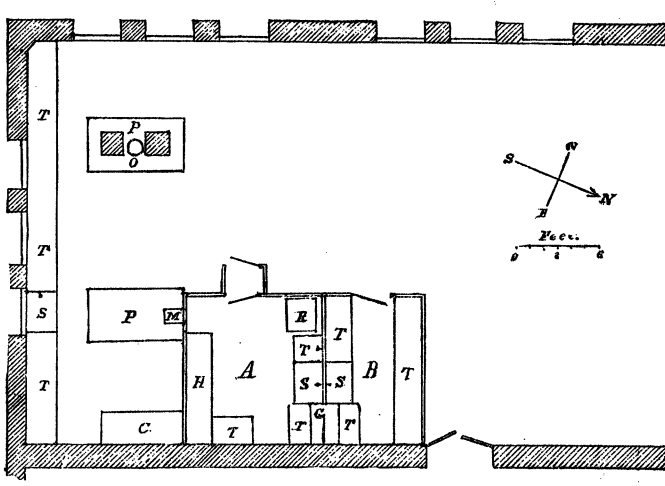
*The new photographic laboratory.* — Since the recent invention of the gelatine dry-plate, photogra-

phy has been advancing rapidly in the number of its applications to the arts and to the industrial and applied sciences. The Institute of technology has not been behindhand in recognizing this fact; and in the new building, now nearly completed, a large room in the south-west corner of the basement has been appropriated to the establishment of a photographic laboratory, perhaps the first ever constructed in connection with a scientific institution, for the especial instruction of students in photographic manipulations, and for purposes of original research, in this most interesting department of applied science.

The following plan shows the arrangement of a portion of the room, which measures sixty feet in length by thirty in breadth.

*P*, *P*, are two brick piers surmounted by solid stone slabs, and constructed on foundations entirely independent of the building, in order to avoid all possibility of shock or jarring. Upon one of these, brick columns are built, which pass through the ceiling into the 'fourth-year' physical laboratory, which occupies the room above. The other one reaches a height of three feet, and forms a solid foundation for the support of a heliostat, microscope, spectroscope, or other instrument. *A* and *B* are the two dark rooms, entirely separated from one another by a partition, and by a wooden frame containing the gas-jet *G*, which is partially surrounded on three sides by sheets of Carbutt's ruby paper. *S*, *S*, *S*, are soapstone sinks, the two former of which are supplied with vacuum pipes for the purpose of accelerating filtration. *T*, *T*, *T*, represent tables, the one in the window being used for printing purposes, while the others are to support photographic apparatus and accessories. Gas will be introduced into the dark rooms over the sinks for lighting when they are not in photographic use. It will also be supplied at the small square table in the larger dark room for heating purposes, such as boiling emulsions. *C* is a case of shelves and drawers to contain books, paper, and apparatus. *H* is a series of shelves for the storage of plates and chemicals. *M* is a square wooden box resting on the pier, but connecting by an aperture measuring ten inches by twelve with the interior of the larger dark room. This is to contain a microscope for researches in photomicrography, the light coming from the heliostat through a small hole in the box. The image is thence projected upon a screen placed inside the dark room, where the operator can examine it at his leisure. This screen is supported upon the focusing table *R*, which rolls upon a track, and may be placed at any distance less than three metres (ten feet) from the aperture at *M*. The dark room is thus converted into a large camera, inside of which the operator stands and exposes his plate, while he may at the same time be developing another one previously taken. The greatest efficiency, convenience, and economy of time are thus combined by this arrangement.

Both dark rooms are constantly ventilated by a system of double walls, with openings at the ceiling and floor, whilst the draught of the lamp *G* is utilized to increase the circulation. The light thus becomes a source of health, instead of vitiating the atmosphere, as is the case in most dark rooms. The room *A* is provided with double doors, so that the operator may leave the room at any time during an exposure, without the slightest fear that even the most sensitive plate could possibly be fogged by a chance ray of stray light. This arrangement, though convenient at all times, will be particularly so when working with long exposures of two or three hours in length; and, indeed, it is only by some such arrangement that these exposures become possible. Besides the aperture at *M*, a smaller one six inches square is made through the wall of the dark room. This is intended for spectroscopic and astronomical work. Either window may be closed by a sliding shutter when the other is in use.



PLAN OF PHOTOGRAPHIC LABORATORY.

Between the brick columns of the pier *P* is placed a shelf, on which will be kept a large carboy containing a saturated solution of potassium oxalate, from which the developer bottles may constantly be replenished by means of a siphon permanently attached. We thus avoid the trouble of continually making up fresh solutions, and at the same time do not require to have the developer bottles inconveniently large. The hyposulphite-of-soda and sulphate-of-iron solutions will be similarly provided for, the latter being covered with a thin film of oil to prevent oxidation from the air.

The routine work of the department will be arranged somewhat as follows. Only those students at the institute taking the courses in mechanical and electrical engineering, architecture, chemistry, natural history, physics, and the general courses, will

receive photographic instruction. Each of them will be required to perform at least ten hours' work, divided into five days of two hours each.

Some experience has already been attained in teaching photography upon a small scale (last year this department had sixteen students); but, should the present venture prove a successful one, it is hoped it may be adopted by other colleges, and that photography may in the future come to be regarded as a necessary portion of every professional man's college education.

WM. H. PICKERING.

## NOTES AND NEWS.

IT is generally known that Williams college secured a table early last year at Dohrn's international station at Naples. The table may be occupied by any American scientific scholar recommended by the faculty of the college. Any one wishing to use the table should send an application to President Carter, and the application should be accompanied by evidence of ability to improve the unrivalled facilities for original investigation afforded at Naples.

Each occupant is expected, soon after his return, to give a brief course of lectures at Williamstown on some subject connected with zoölogical work. The lectures by the first occupant, Dr. Edmund B. Wilson, formerly fellow in the Johns Hopkins university, are to be given in January and February.

In assigning the table, any regular graduate of Williams college will be recognized as entitled to precedence; but, in case no graduate of the college worthy of the honor is an applicant for the position, the appointment will be determined as far as possible by distinction already attained. The successful applicant will be at once informed of his appointment, and his name communicated to *Science* and the *American naturalist* for publication.

The table is at present used by Dr. Samuel F. Clarke, professor of natural history in Williams college, but will probably be vacated on or before April 1, 1884.

— The department of the interior, at the request of the Italian government, has issued a circular, calling attention to the Bufalini prize of five thousand lire for an essay on the experimental method in science, and giving the conditions under which writers must compete. The character of the essay may be gathered from the following extract from Bufalini's will: —

"Let the learned consider, therefore, whether they can pardon me for daring to appeal to them ten years after my death, and after that every twenty years, to solve the following problem: the necessity of the experimental method in arriving at the truth and the relation of all the sciences being assumed, it is required to demonstrate in a first part how far the said method is to be used in every scientific argument, and, in a second part, to what extent each of the sciences has availed itself thereof during the time that has elapsed since the last competition for a prize, and how they may be brought to a more faithful and complete observance of the method itself."

— According to *Nature*, a meeting was recently held in Sheffield for the purpose of carrying out, in connection with Firth college, a proposed technical department having reference to the trade of the district. Among those who spoke were Mr. Mundella and Dr. Sorby; and all agreed as to the desirability of establishing such a department, and the necessity of educating the captains as well as the privates of industry in the principles of their crafts. For that, Mr. Mundella insisted, is the true technical education. He gave the experience of a friend who has just been visiting the United States, and inspected the means for technical education existing there. The distinct conclusion was, "that there is more skill and intelligence in American industrial pursuits than there is in our English industrial pursuits."

— At the meeting of the Institution of civil engineers, Nov. 27, the paper read was on 'The new Eddystone lighthouse,' by Mr. William Tregarthen Douglass.

The necessity for the construction of a new lighthouse on the Eddystone rocks had arisen in consequence of the faulty state of the gneiss rock on which Smeaton's tower was erected, and the frequent eclipsing of the light by heavy seas during stormy weather. The latter defect was of little importance for many years after the erection of Smeaton's lighthouse, when individuality had not been given to coast-lights; but, with the numerous coast and ship lights now visible on the seas surrounding this country, a reliable distinctive character for every coast-light had become a necessity. The tower of the new Eddystone is a concave elliptic frustum, with a diameter of 37 feet at the bottom, standing on a cylindrical base 44 feet in diameter and 22 feet high, the upper surface forming a landing platform 2 feet 6 inches above high water. The cylindrical base prevents in a great measure the rise of heavy seas to the upper part of the tower, and has the further advantage of affording a convenient landing-platform, thus adding considerably to the opportunities of relieving the lighthouse. With the exception of the space occupied by the fresh-water tanks, the tower is solid for 25 feet 6 inches above high-water spring-tides. At the top of the solid portion the wall is 8 feet 6 inches thick, diminishing to 2 feet 3 inches in the thinnest part of the service-room. All the stones are dovetailed both horizontally and vertically, as at the Wolf Rock lighthouse. Each stone of the foundation-courses was sunk to a depth of not less than 1 foot below the surface of the surrounding rock, and was further secured by two Muntz-metal bolts 1½ inches in diameter, passing through the stone and 9 inches into the rock below, the top and bottom of each stone being fox-wedged. The tower contains nine rooms, the seven uppermost having a diameter of 14 feet and a height of 10 feet. These rooms are fitted up for the accommodation of the light-keepers and the stores necessary for the efficient maintenance of the lights. They are rendered as far as possible fireproof, the floors being of granite covered with slate. The stairs and partitions are of iron, and the windows and shutters of gun-metal. The oil-rooms contain eighteen wrought-iron cisterns capable of storing 4,300 gallons of oil; and the water-tanks hold, when full, 4,700 gallons. The masonry consists of 2,171 stones, containing 62,133 cubic feet of granite, or 4,668 tons. The focal plane of the up-

per light is 133 feet above high water, its nautical range is 17½ miles, and in clear weather it overlaps the beam of the electric lights from the Lizard Point. The lantern is of the cylindrical helically-framed type adopted by the Trinity House. The light is derived from two six-wick 'Douglass' burners, the illuminant being colza-oil. With a clear atmosphere, and the light of the Plymouth breakwater lighthouse (10 miles distant) distinctly visible, the lower burner only is worked at its minimum intensity of 450 candles, giving an intensity of the flashes of the optical apparatus of 37,800 candles; but, whenever the atmosphere is so thick as to impair the visibility of the breakwater-light, the full power of two burners is put in action, with the aggregate intensity of 1,900 candles for the lamps, and an intensity of the optical apparatus of 159,600 candles. This intensity is about 23.3 times greater than that of the fixed light latterly exhibited from Smeaton's tower, and about 3,282 times that of the light first exhibited in the tower from tallow candles. The new tower was built at a distance of 130 feet from Smeaton's lighthouse, a large portion of the foundation being laid below the level of low-water spring-tides. The estimate for the work was £78,000, and the cost £59,255. The first landing at the rock was made in July, 1878, and the work was carried on until December. Around the foundation of the base of the tower a strong coffer-dam of brick and Roman cement was built for getting in the foundations. By June, 1879, the work was sufficiently advanced for the stones to be laid in the lower courses, and every thing was arranged for H.R.H. the Duke of Edinburgh to lay the foundation-stone on the 12th of the month; but, the weather being stormy, the ceremony was postponed until the 19th of August. On the 17th of July, 1880, the cylindrical base was completed, and the 38th course by the early part of November. On the 1st of June, 1881, the Duke of Edinburgh, when passing up the Channel in H.M.S. Lively, landed at the rock, and laid the last stone of the tower. On the 18th of May, 1882, the Duke of Edinburgh completed the work by lighting the lamps and formally opening the lighthouse. The edifice was thus erected and fitted up within four years of its commencement, and one year under the time estimated. The whole of the stones, averaging more than 2 tons each, were landed and hoisted direct into the work from the deck of the steam-tender Hercules, by a chain-fall working between an iron crane fixed at the centre of the tower, and a steam-winch on the deck of the Hercules, which was moored at a distance of 30 fathoms from the rock.

The town council and inhabitants of Plymouth having expressed a desire that Smeaton's lighthouse should be re-erected on Plymouth Hoe, in lieu of the Trinity House sea-mark thereat, the Trinity House made over to the authorities at Plymouth the lantern and four rooms of the tower. After the removal of the structure to the floor of the lower room, the entrance-doorway, and well-staircase leading from it to the lower room, were filled in with masonry, and an iron mast was fixed at the centre of the top of the frustum.

— The U. S. naval institute offers a prize of a gold medal, one hundred dollars, and a life membership, to the writer of the best essay offered on the subject of 'The best method for the reconstruction and increase of the navy.' The judges selected to adjudge the prize are Dr. D. C. Gilman, Admiral C. R. P. Rodgers, Senator J. R. Hawley.

— E. & F. N. Spon announce the publication at an early date of a book on 'Sorghum, its culture and manufacture economically considered,' by Peter Collier; also 'Electricity, magnetism, and electro-telegraphy,' by D. T. Lockwood.

— Professor Gustavus Hinrichs, director of the Iowa weather-service, has again issued an attractive annual pamphlet, entitled this year 'The seasons in Iowa, and a calendar for 1884,' with appropriate illustrations, and much valuable meteorological information. The notable weather features of the several months are given in detail; so that observers may judge at any time whether an occurrence is normal and probably to be continued, or abnormal and likely soon to disappear. The chief peculiarity of the climate is its variability, common to interior stations on the track of frequent cyclonic storms, and of which several striking examples are given; and there is found to be much probability of a cold snap late in January, a snow-storm at the close of April, a cold spell in May, tornadoes in June, squalls in July, heavy local rains in August, and frost early in September. Since 1875, tornadoes have occurred in Iowa on the following dates: April 8, 18, **21**, 23; May 9, 13, 18, 19; June 1, 4, **9**, **11**, 12, 14, **17**, 24; July 2; Oct. 8, 15, 28, 30 (the more severe ones in bold type). June is the month most disturbed by these storms; and directly after it a three-month period, July 3 to Oct. 8, has no record of tornadoes. It is said that the danger from tornadoes in Iowa has been greatly exaggerated. The rainfall maps for every month and for the year are repeated from last year. Precipitation is almost three times as great in summer as in winter. Professor Hinrichs hopes next year to illustrate his annual from home sources exclusively, and asks for sketches and photographs of halos, hail-stones, destructive effect of wind and lightning, meteors, cloud-forms, or any other phenomena. Drawings of Iowa scenery, as well as detailed maps of storms, hail, and floods, will all be welcome. We wish the director success in his excellent work.

— The publications of the census office so long expected are now being issued in rapid succession by the Government printing-office. Thus far, three quarto volumes, besides the compendium, have appeared, and several others are very near completion. The three which have been issued are those upon population, manufactures, and agriculture. The first, which saw the light some two months ago, comprises 'Population, part 1,' as issued by the census office a year and a half ago, with, as additions, the tables relating to race, nativity, age, sex, parentage, occupations, illiteracy, the defective, dependent, and delinquent classes, and the newspaper and periodical press. The tabular matter is preceded by a somewhat full discus-

sion of the progress and movement of population, which is illustrated by numerous colored charts relating to the progress of settlement, and the distribution of the different elements of the population. Other subjects, such as inter-state migration, immigration and nativity of the population, and occupations, are ably discussed by the late superintendent, Gen. Walker, in remarks introductory to the tables relating to these subjects. The volume is a bulky one, contianing, with its full index, 1,050 pages. It contains, also, forty-two colored maps, of which twenty-eight are double-page maps, and thirty other full-page illustrations.

The volume upon manufactures, which has but recently appeared, is an equally bulky tome, comprising 1,248 pages. The opening discussion, by Gen. Walker, is brief, comprising but thirty-five pages; and, while it is suggestive rather than exhaustive, it skims the cream from the whole body of statistics. The tables present: 1°. General statistics regarding manufactures, by states and territories, in 1880, 1870, 1860, and 1850; 2°. The statistics for the whole country, of certain specified industries, some three hundred and fifty in number; 3°. Similar statistics for each state and territory; 4°. General statistics by counties; 5°. Statistics regarding selected branches of manufactures by counties; 6°. The manufactures of a hundred leading cities; and 7°. Special statistics regarding certain leading industries. The statistical portion of the volume occupies four hundred and seventy-six pages. The report of Mr. Hollerith upon 'Power' consists of tables, showing by states the amount of steam and of water power in use, and also the power applied to certain leading industries in the several states. The statistics are prefaced by a few pages of discussion, in which the leading points are brought out. The report is accompanied by four colored charts of the eastern part of the United States, showing, by shades of color, the total power in use, the steam-power, and the water-power, each in proportion to area, and the local excess of steam and of water power. There are also three sheets of diagrams, illustrating the proportions of power in different industries and in the several states and territories. In his able treatise upon the Factory system of the country, Col. Wright sketches the origin and history of that system; treats of its evil effects, both moral and physical, particularly upon women and children, of its influence upon wages, prices, and production; and summarizes the legislation of the several states in regard to factory operatives. To the houses of factory operatives he devotes much attention, illustrating his text with plans and elevations of many houses for operatives, selected from foreign and American examples. This paper is a very instructive one, both economically and socially. The report of Mr. Fitch, upon Interchangeable mechanism, treats of the manufacture of fire-arms, ammunition, sewing-machines, locomotives, watches, clocks, and agricultural implements. He sketches the history and progress of these branches of manufacture in this country, and details the most recent improvements. This report, as well as that by the same author upon hardware and cutlery, is fully illustrated with cuts. The report upon Iron and steel production, by James M. Swank, secretary of the American iron and steel association, is here reprinted. It was first issued by the census office as a separate publication, being the first complete report published by that office. Mr. Swank precedes the statistics of production by a very full discussion, and closes the report with an extremely interesting and valuable history of the iron and steel industry, not only in this country, but in the civilized world; beginning with Tubal Cain, in the seventh generation after Adam. The report is illustrated with six double-page charts, showing the iron-producing regions of the country, and the production, by counties, of pig-iron, rolled iron, wrought-iron blooms, and steel. The report upon Silk manufacture, by Mr. Wyckoff, consists of a summary of its history, and a very full sketch of its present condition in this country. That upon Cotton manufacture, by Mr. Atkinson, is extremely brief, comprising only sixteen pages: it opens with a summary of the cotton-producing countries of the globe, the sources of supply of the staple, and goes on to discuss the methods of manufacture, and the relative qualities of the product of this and European countries, and the facilities offered by different parts of this country for this industry. The report of Mr. Bond consists entirely of statistics relating to the industry of wool manufactures, prefaced by a few introductory remarks. The report upon Chemical products treats of the production of soda, manufactured manures, phosphates, sulphur and sulphuric acid, potassium bichromate, potash, phosphorus, borax, bromine, nitroglycerine, acetate of lime and salt. The volume closes with Mr. Weeks's report upon Glass manufacture. In addition to full statistics regarding this industry, Mr. Weeks summarizes and discusses the statistics fully. This portion of the report is followed by a treatise upon glass, the materials used in its manufacture, and the methods employed both in manufacture and in working. The report closes with a history of the industry from the earliest historic times. An admirably full and complete general index is given, in addition to the indices to the several reports. Probably with a view to a separate publication of each special report, each is paged by itself on the top, while at the bottom the paging runs consecutively through the volume.

— S. E. Cassino & Co. desire us to state that they have bought the interest of Estes & Lauriat in the 'Standard natural history,' and are now the sole publishers of that work.

Mr. J. H. Emerton, whose name was given as a contributor to this work, writes that he is only so in so far as a part of the chapter on spiders is quoted from what he had published elsewhere.

— *La Nature*, Dec. 15, 1883, apologizes for an error in stating that Mr. Ferry crossed the English Channel on the water-tricycle figured in *Science*, Dec. 14, and gives illustrations of the tricycle, convertible into a boat, in which the passage was actually made.